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REPORT

OF THE

SPECIAL COMMISSION

CHICAGO DRAINAGE CHANNEL

TO THE

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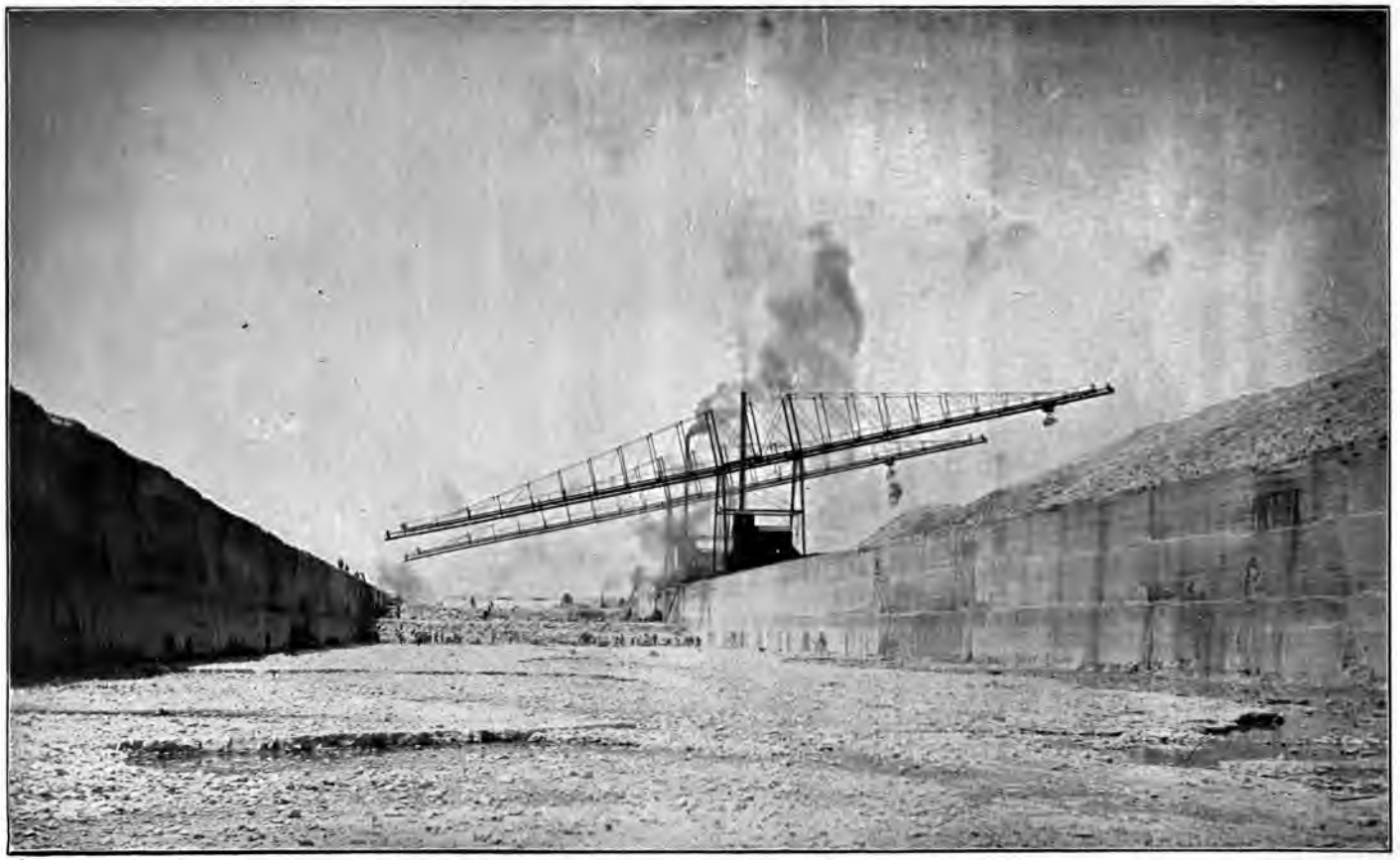

Special commissioners, Chicago drainage.

SPECIAL COMMISSIONERS CHICAGO DRAINAGE CHANNEL

REPORT

OF THE

SPECIAL COMMISSION

APPOINTED BY

HON. JOHN R. TANNER

GOVERNOR OF ILLINOIS

UNDER SECTION 27 OF THE "ACT TO CREATE SANITARY DISTRICTS AND TO REMOVE OBSTRUCTIONS IN THE DESPLAINES AND ILLINOIS RIVERS AND THE DAMS AT HENRY AND COPPERAS CREEK," APPROVED MAY 29, 1889

COMMISSIONERS

ISAAC TAYLOR, PEORIA, ILL., *President*
JOHN LAMBERT, JOLIET, ILL.
AL. F. SCHOCH, OTTAWA, ILL., *Secretary*

DESMOND FITZGERALD, *Chief Engineer*

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PRESS OF
CAMERON, AMBERG & CO.
CHICAGO

SPECIAL COMMISSIONERS' REPORT.

CHICAGO, June 14, 1900.

HON. JOHN R. TANNER,
Governor of Illinois:

The Special Commission, consisting of Isaac Taylor, Peoria, Illinois; Al. F. Schoch, Ottawa, Illinois, and John Lambert, Joliet, Illinois, appointed by your Honor on May 9, 1899, under Section 27 of the "Act to Create Sanitary Districts and to remove obstructions in the Desplaines and Illinois Rivers, and the Dams at Henry and Copperas Creek," for the purpose of making an examination of the work authorized by said Act, respectfully report as follows:

ORGANIZATION.

Your Commission met pursuant to Section 27 of said Act, at the Great Northern Hotel, in the City of Chicago, Illinois, on May 15, 1899, and organized by the election of Isaac Taylor, President; Al. F. Schoch, Secretary and Treasurer; Miss Emily H. Selby, Clerk and Official Stenographer; they also appointed C. W. Brown, of Joliet, Illinois, Counsel, and later, on October 2, 1899, Henry Mayo, of Ottawa, Illinois, was added as Assistant Counsel.

The office of the Commission was established at 806 and 807 Security Building, in the City of Chicago.

FINANCIAL OBSTACLES.

After a careful reading of the Act and conference held with counsel, your Commission at once met with a serious obstacle in the law, which had to be removed before any engineer could

be engaged or the work of inspection begun. In Section 27 of the Act the following clause appears:

"Such Commissioners and engineer shall receive for their services ten dollars per day each, and their reasonable expenses and outlays for the time by them necessarily employed in the discharge of their duties, which shall be paid to them from the State Treasury; and the said sanitary district shall reimburse the State for all expenses and disbursements on account of said Commission."

Upon inquiry and investigation we found that it would be utterly impossible to procure, for the sum of ten dollars per day, a prominent and skilled engineer, one of national reputation, to take in hand the task required, to pass on this great work. We further found that the last Legislature had made no appropriation for defraying the expenses to be incurred by our Commission.

These two important matters, the right of paying an engineer more than ten dollars per day for his services, and the failure to make an appropriation for the use of the Commission, were at once presented to the Sanitary Trustees, and, after several conferences, realizing the situation, they finally agreed to appropriate, for the use of our Commission, twenty-five thousand dollars, and further, to allow our Commission the right to pay for the services of a chief engineer such sums over and above ten dollars per day as might be required, which agreement was confirmed by the passage of the following ordinance by the Sanitary Trustees, on June 3, 1899:

ORDINANCE.

WHEREAS, The Act of the General Assembly of Illinois, under which was organized the Sanitary District of Chicago, provides that the compensation and expenses of the State Commission and engineer, in the inspection of the Drainage Channel, in accordance with Section 27 of said Act, shall be paid

from the State Treasury and the State reimbursed therefor by the Sanitary District of Chicago; and

WHEREAS, The Forty-first General Assembly of the State of Illinois failed to make any appropriation for the payment of the Commissioners who have just been appointed by the Governor, or for an engineer and other services and expenses requisite for a proper inspection of the Drainage Channel; and

WHEREAS, The necessity for immediate inspection and report by said Commissioners is of paramount importance to the Sanitary District of Chicago, the Desplaines and Illinois Valley and the inhabitants thereof; and

WHEREAS, The salary of ten dollars per day fixed by the statute is inadequate for the services of a civil engineer of such competence and experience as to expeditiously perform the work of surveying and inspection, within the time necessary to permit the opening of the channel to its usefulness on the date at present contemplated; and

WHEREAS, It is the sense of the Board of Trustees of the Sanitary District of Chicago that the State Commission aforesaid will find it necessary and will be justified in paying to the engineer selected by them and provided for in Section 27 of said Act, a salary in excess of that contemplated by law; therefore

Be it Resolved, That, in order to meet the emergency and conform with the necessities set forth in the foregoing preamble, the sum of twenty-five thousand dollars be and the same is hereby appropriated from the treasury of the Sanitary District of Chicago for the use of the State Commission appointed by the Governor of Illinois in accordance with Section 27 of the "Act to create sanitary districts and remove obstructions in the Desplaines and Illinois Rivers," and that said amount be placed to the credit of said State Commission, in the Chicago National Bank, subject to the order and warrants of said Commissioners, on the approval of the Governor of the State of Illinois, to meet the salaries and other expenses to be incurred by said Commission

in making the inspection of said Drainage Channel in accordance with said Act, and including such additional sum said Commission may find it necessary to pay for the services of a competent engineer over and above the per diem of ten dollars provided by the statute.

ORGANIZATION OF ENGINEERING DEPARTMENT.

The question of finance and salary of engineer now solved, active work commenced, and the Commission entered the field for the procuring of a competent chief engineer. Realizing the magnitude of this great work, the many complex engineering problems to solve, and the importance to the Governor, as well as to the people of the Illinois Valley and the State, that the channel should be constructed according to the requirements of the law, the Commission determined to procure an engineer of the highest standing in his profession, and one well versed in the practice of hydraulic engineering.

Applications came by the score from all quarters, correspondence was entered into with many, and finally, after several conferences with your Honor and Mr. E. F. Leonard, a gentleman well informed in engineering questions, the selection fell to Desmond FitzGerald, of Boston, Massachusetts, at present Department Engineer of the Metropolitan Water Board of Massachusetts, who was appointed on June 8, 1899, and, upon notification of his appointment, came to Chicago and immediately entered upon his duties.

Conferences and consultations were held with counsel for your Commission, the Act fully discussed in all its details, and instructions given to the Engineer for his guidance in the work.

A corps of workers was at once organized, consisting of a force of one hydraulic engineer, three assistant engineers, one draughtsman, one level man, two rod men, two boat men and one ax man. With this force the practical work of making surveys, investigations and soundings of the channel and river began.

DUTIES.

Under Section 27 of the Act, your Commission was empowered as follows:

"The said Commission shall take as their datum line for the survey the datum established by the Illinois and Michigan Canal Trustees in 1847, and shall make such examination and surveys of Chicago River, and of the channel or channels authorized by this Act as shall enable them to ascertain whether said channel is of the character and capacity required by this Act. And in case they shall find the work in all respects in accordance with the provisions of Section 23 of this Act, they shall so certify to the Governor, who shall thereupon authorize the water and sewage to be let into said channel. But in case said Commissioners shall find said channel is not constructed in accordance with the provisions of this Act, it shall be their duty to file in any court of competent jurisdiction, on the chancery side thereof, in their name as such Commissioners, a bill against said corporation, which bill shall set forth wherein said work is deficient and fails to comply with the provisions of this Act; and said court shall thereupon issue an injunction without bond against said defendant, enjoining and restraining it from admitting water or sewage into said channel until the final order of the court. And in case said court, upon hearing, shall determine that said channel is not constructed in accordance with the provisions of this Act, said injunction shall be continued until the provisions of this Act shall have been fully complied with."

CHANNEL—HOW CONSTRUCTED.

Your Commission was also to take into consideration the manner of construction of the channel, as provided in Section 23, which reads as follows:

"If any channel is constructed under the provisions hereof by means of which any of the waters of Lake Michigan shall be caused to pass into the Desplaines or Illinois Rivers, such

channel shall be constructed of sufficient size and capacity to produce and maintain, at all times, a continuous flow of not less than 300,000 cubic feet of water per minute, and to be of a depth of not less than fourteen feet, and a current not exceeding three miles per hour, and if any portion of any such channel shall be cut through a territory with a rocky stratum where such rocky stratum is above a grade sufficient to produce a depth of water from Lake Michigan of not less than eighteen feet, such portion of said channel shall have double the flowing capacity above provided for, and a width of not less than one hundred and sixty feet at the bottom, capable of producing a depth of not less than eighteen feet of water."

CAPACITY.

The capacity of the channel was also to be considered and passed upon, as required under Section 20 of the Act, which says:

"Any channel or outlet constructed under the provisions of this Act, which shall cause the discharge of sewage into or through any river or stream of water beyond or without the limits of the district constructing the same, shall be of sufficient size and capacity to produce a continuous flow of water of at least two hundred cubic feet per minute for each one thousand of the population of the district drained thereby, and the same shall be kept and maintained of such size and in such condition that the water thereof shall be neither offensive or injurious to the health of any of the people of this State, and before any sewage shall be discharged into such channel or outlet, all garbage, dead animals, and parts thereof, and other solids, shall be taken therefrom and said district shall, at the time any sewage turned into or through any such channel or channels, turn into such channel or channels not less than 20,000 cubic feet of water per minute for every 100,000 inhabitants of said district, and shall thereafter maintain the flow of such quantity of water."

INCREASED FLOW.

The law also provided that in the event of an increased population the amount of water to be turned into the channel should be increased accordingly, as shown in Section 23 below, which increased flow is further provided for in Section 25, and which question necessitated the finding of the population of the Sanitary District.

"If the population of the district draining into such channel shall at any time exceed 1,500,000, such channel shall be made and kept of such size and in such condition that it will produce and maintain at all times a continuous flow of not less than 20,000 cubic feet of water per minute for each 100,000 of the population of such district, at a current of not more than three miles per hour, and if at any time the general government shall improve the Desplaines or Illinois rivers, so that the same shall be capable of receiving a flow," etc.

DEDUCTIONS.

From these sections of the Act six very important propositions are set forth for determination and final solution by the Commission.

First. That the channel shall have the capacity to flow and maintain at all times the minimum of 300,000 cubic feet of water per minute, and where the channel is dug through a rocky stratum said portion shall have a capacity to flow 600,000 cubic feet per minute and have a depth of not less than eighteen feet of water.

Second. That the flow shall be 20,000 cubic feet of water per minute to each 100,000 of the inhabitants of the district.

Third. The ascertaining of the population of the Sanitary District at the present time.

Fourth. That the flow required under the law for the population estimated in the district shall be maintained at all times.

Fifth. That the Chicago River shall fully meet the requirements as to capacity to flow into the Channel the amount of water required by our Commission under the Act.

Sixth. That the current in the Channel and Chicago River shall not exceed three miles per hour.

FINDINGS AS TO CHANNEL.

In making the examination the engineering department took cross sections of the channel every 800 feet throughout its length, from Robey street to Lockport, a distance of twenty-eight miles, showing depth, width and area; and from these surveys, and calculations made therefrom, found that the channel meets the requirements of the Act as to construction, quantity of flow and velocity, namely: that the alluvial portion has a capacity of 360,000 cubic feet of water per minute and a depth greater than fourteen feet at a current not to exceed three miles per hour; and that the rocky portion has a capacity of 600,000 cubic feet of water per minute, a width at the bottom of 160 feet and a depth greater than eighteen feet at a current not to exceed three miles per hour.

POPULATION.

In Sections 23 and 25 of the Act we find the following: "The flow of water through the channel shall not be less than 20,000 cubic feet of water per minute for each 100,000 of the population of the district," which made it necessary for your Commission to determine the number of inhabitants in the Sanitary District. Our Chief Engineer investigated this subject very thoroughly, considering the returns from the United States and School censuses, and all other available data. He found that the population of the Sanitary District exceeded 1,800,000, which, according to the provisions of the Act in Sections 23 and 25, would require a continuous flow of water in the Chicago River and Main Drainage Channel of 360,000 cubic feet of water per minute.

FINDINGS AS TO CHICAGO RIVER.

As to the Chicago River, cross sections were taken 200 feet apart from Bridgeport to the lake, for the purpose of ascertaining its capacity, and these surveys compared with those of the government engineers for the purpose of verification. With the dredging done as planned and the great number of improvements made by the Sanitary Trustees along the banks of the Chicago River, which increased its width, and the building of the by-passes at Adams and Van Buren Streets, which adds about one thousand square feet of cross section at these points, we find that the Chicago River is also within the requirements of the law and will flow the 360,000 cubic feet of water per minute at a current not to exceed three miles per hour.

CURRENT IN CHICAGO RIVER.

One of the perplexing questions before your Commission concerning the Chicago River was that of taking into consideration, in making our calculations, the question of a one and one quarter mile current. This question arose from the fact that the application of the Trustees of the Sanitary District of Chicago to the Secretary of War for permission to cause the waters of the Chicago River to flow into the main channel restricted the velocity of said river to one and one-quarter miles an hour; and, further, as the permit from the Secretary of War to the Trustees also contained in the preamble the restriction of the current to one and one-quarter miles per hour, we were for a long time in doubt as to whether this restriction of the velocity should be taken into consideration in determining the capacity of the Chicago River.

Your Commission, deeming this an important point, and in order that we might arrive at a proper conclusion, submitted the question to our Counsel for a legal opinion.

Said Counsel, after due consideration, reported that, under the Act creating the Sanitary District, our Commission had no

legal right to consider the one and one-quarter mile current as mentioned in the permit from the Secretary of War, as the law, under Section 27, specifically says "of a current not to exceed three miles per hour," which velocity is intended for both river and channel. We herewith append question submitted and answer from Counsel:

"Should the Commission, in estimating the capacity of the Chicago River, from Lake Michigan to Robey Street, take into consideration the velocity of the current?"

"This is understood to refer to the current setting from the lake into the Drainage Channel and will be answered upon that assumption.

"Under Section 23, the Chicago River and the channel (drainage) would constitute practically one waterway, and the limitation of a three-mile per hour current therein applies to both. That is, the specified velocity, in furnishing the quantity of water, under the provisions of the Sanitary Act, cannot exceed, in river or channel, a current of three miles per hour. Consequently, the duties of the Board require the consideration and determination of this question.

"In connection with the Secretary's letter of October 19, there were furnished copies of correspondence between the Sanitary District and the Secretary of War, touching permission to improve the Chicago River by widening and deepening, and it is understood that the matter of greatest moment is, the status of the Chicago River with reference to Federal control; whether or not your Board should take into consideration, in reaching the final decision, the permission or lack of permission the Sanitary District has, from the United States authorities, to divert or use the waters of the river, under the provisions of the State law.

"The Chicago River, with its branches, lies wholly within the State of Illinois. By means of Lake Michigan, it affords facilities for commerce between the City of Chicago and ports

in other States and countries. It is a navigable river, as has been repeatedly held by courts of last resort. As such, it is subject to the power vested in the General Government to regulate interstate and foreign commerce. This involves the control of its waters, so far as it may be necessary to insure free navigation, with other waters forming a continuous channel for commerce among the States or foreign ports.

"Subject to this paramount power—vested in Congress—the State of Illinois may regulate and manage the use of the river and its waters; may build dams, abutments for bridges, authorize ferries, construct tunnels, dredge its bed, widen its channel, and many other things conducive to the convenience and prosperity of its people. If this power be exercised so as to unnecessarily obstruct or interfere with navigation, Congress may interfere and remove the obstruction. If the power of the State and of the Federal Government come in conflict, the latter must control and the former yield. But until Congress acts on the subject, the power of the State over its navigable waters is plenary.

"In the exercise of these powers, the State Legislature passed the Act of 1889, under which the Sanitary District is organized. In its passage, and in the acceptance of its provisions by the citizens of the District, it is to be presumed there was full knowledge of the limitations of power above set forth. The risk of interference, by the Federal Government, was necessarily assumed both by the legislative body and those seeking the benefits of the law so enacted. In no way could the State evade or avoid the effects of this superior right of the General Government. It is doubtful if Congress even can authorize the diversion of the waters of a navigable river, to an extent that it would be a substantial and permanent injury to navigation.

"These principles applying, the Legislature did not and could not, in the Sanitary Act, attempt any control of the Federal relation. It might undoubtedly have provided, and as

a condition precedent, that in any unusual use of the Chicago River (such as diversion of its water into the proposed channel) the consent of the Government should first be obtained. It might have provided that no tax levy should be made to construct the contemplated work before permission had; and in so doing have protected its citizens from a possible payment of large sums, in taxes, to no purpose—or a useless one.

"However, it was not so done, and it is not perceived that your Board of Commissioners has any authority to take cognizance of this matter. To do so would require, practically, to write into the statute, from which it derives its powers, something the Legislature did not see fit to insert.

"Furthermore, should it take notice of this question, it must, in effect, organize itself into a court, to pass upon the laws of Congress—their scope and effect—to determine by whom and in what manner permission to divert the waters of the Chicago River should be given—to pass upon the sufficiency or insufficiency of any such permit, or in a word to exercise the functions of a Federal Court. The conclusion therefore is, that your Board has no jurisdiction to exercise, or duties to perform, in this regard.

"Moreover, Section 27 *supra*, provides: 'In case said Commissioners shall find said channel is not constructed in accordance with the provisions of this Act, it shall be their duty to file in any court of competent jurisdiction, in their name as such Commissioners, a bill against said corporation, which bill shall set forth wherein said work is deficient and fails to comply with the provisions of this Act; and said court shall thereupon issue an injunction without bond against said defendant, enjoining and restraining it from admitting water or sewage into said channel until the final order of the court. And in case said court, upon hearing, shall determine that said channel is not constructed in accordance with the provisions of this Act, said injunction shall be continued until the provisions of this Act shall have been fully complied with.'

"A bill filed simply setting forth that the Sanitary District had not obtained permission of the United States authorities to flow water into the channel, from the river, at a rate exceeding one and one-quarter miles per hour (an insufficient speed) would not appear to fall within the above langnage. The court, when such bill is directed to be filed, is to continue its injunction *only* until the *provisions of the Act* have been complied with. The Act itself containing no provisions requiring any permit to be first obtained, the court would be without power to continue an injunction on such ground alone.

"It therefore is apparent that, while the velocity of the current in the Chicago River, up to three miles per hour, is an important factor, proper to enter into the findings of the Special Commission; the attitude of the Secretary of War, or the Federal authorities, in relation thereto, is not within the scope of its investigations."

BRIDGES.

Under Section 12 of the Act, it is provided that, "All bridges built across the channel shall not necessarily interfere with or obstruct the navigation of such channel when the same becomes a navigable stream, as further provided in Section 24." We would report that an examination has been made of all the bridges thus far built across the channel and the river by the Sanitary District and find them of approved types of bascule or swing bridges, all constructed in a substantial and workmanlike manner and so that they do not necessarily interfere with navigation. Your Commission has examined the contracts for the bridges not yet built or in process of construction and finds that they also come within the requirements of the law.

Under the Act, however, the Sanitary Trustees are not to operate the said bridges as movable ones for a period of seven years from the time water has been turned into the channel, unless the needs of general navigation on the Desplaines River and Illinois River, when connected with the said channel, sooner require it.

CONTROLLING WORKS.

These works, located at the lower end and on the west side of the main channel at Lockport, consist of a bear trap dam, 160 feet in width, which is operated by the pressure of the water above it and is thus raised and lowered to control the flow of water from the main channel into the tail race. There are also seven sluice gates, each thirty feet in width, ready for operation. To supplement the flow over the dam eight additional places have been provided for more gates when the occasion demands. This dam and gates are of the latest improved construction and your Commission witnessed their practical working, on the day they were first opened, and the water turned from the main channel into the Desplaines Valley, and found the said Controlling Works well adapted for the uses intended, namely, the regulation of the flow and current in the Chicago River and main channel.

SOLIDS.

Your Commission finds in Section 20 the following: "And before any sewage shall be discharged into such channel or outlet, all garbage and other solids shall be taken therefrom." We have given this subject considerable attention and study, but have been unable, even with the aid of our Counsel, to arrive at any definite conclusion as to what was exactly intended by this section. We have made, on several occasions, as careful examinations of the Chicago River as possible, and while we must admit there is more or less solids of some nature in all sewage, yet we have been unable to find such solid matter in the river as could be determined with the naked eye. This matter was presented to the Sanitary Trustees by your Commission and they informed us that they had notified their Police Department to prevent the throwing of solids into the channel before the turning in of the water, which is the only provision made concerning this question. Your Commission considered that this

would be a matter for future action by the Health Department of the State of Illinois and, therefore, we saw no valid reason for a further investigation of this question.

DESPLAINES RIVER AND UPPER BASIN.

The tail race constructed by the Sanitary Trustees from the Controlling Works at Lockport to the Desplaines River and the work of excavation in the Desplaines River to the upper basin in Joliet, from the surveys and investigations made by our Chief Engineer, are fully capable of passing the required quantity of water as determined by your Commission. The work of building Dam No. 1 and other work connected with it in Joliet does not, from opinion of our Counsel, come within the jurisdiction of your Commission; the same is being built under a decree of court made as a result of litigation between the Illinois and Michigan Canal Commissioners and the Sanitary Trustees. As to the practicability of the method of construction, etc., we would respectfully refer to our Chief Engineer's report, which we deem of vital importance for future use.

DAMS.

Section 23 of the Act provides as follows: "That the district constructing said channel may remove obstructions in the Desplaines and Illinois Rivers whenever it shall be necessary so to do to prevent overflow or damage along said rivers, and shall remove the dams at Henry and Copperas Creek, in the Illinois River, before any water is turned into the said channel." And further on said section also provides: "And the Canal Commissioners, if they find at any time that an additional supply of water has been added to either of said rivers by any district or districts to maintain a depth of not less than six feet from any dam owned by the State, to and into the first lock of the Illinois and Michigan Canal, at La Salle, without the aid of any such

dam at low water, then it shall be the duty of said Canal Commissioners to cause such dam or dams to be removed." The Sanitary Trustees have at all times been willing and ready to comply with this provision; but the Canal Commissioners, feeling that the removal of the dams would entirely destroy navigation on the Illinois River from La Salle down the lower Illinois River, and further taking the position that the removal of said dams (from their construction of the law) comes within their jurisdiction, protested and finally commenced legal proceedings in the Fulton County Court against the Sanitary Trustees to restrain them from removing the dams. The Court decreed in favor of the Trustees and an appeal was then taken by the Canal Commissioners to the Supreme Court of the State, in whose hands the case now rests for a final decision. Your Commission, desiring to be fair in their investigation and not wishing to keep the people of the City of Chicago unnecessarily from the desired relief in getting rid of the sewage which contaminates the drinking water and injures the health of the community, concluded that, as this was in the hands of the highest tribunal of the State for decision, no further consideration or notice of the matter would be taken in requesting the granting of the final permit.

Your Commission would finally report that, as previously stated, we have made a full and careful investigation of these several important questions, and the work as done, and we find that the Main Drainage Channel and the Chicago River fully come within the requirements of the law as to construction, capacity and current, and that all other work connected with it is practically completed except the construction of a few bridges and the removal of the dams at Henry and Copperas Creek. We had intended to await the decision of the Supreme Court in the dam case before asking your Honor to grant the final permit, but were advised by our attorneys that we would be justified, under the statute, in making a favorable report before a decision

should be made by the Supreme Court, as this question was before the Court and under its jurisdiction. After due consideration of the whole record before us, we wired you on the morning of January 17, 1900, as follows:

"Your Special Commission reports the work of the Sanitary Trustees on the Drainage Channel substantially completed, and meets the requirements of the law, with the exception of the removal of the State dams, which is in the hands of the Supreme Court. We recommend the granting of the final permit. Full official report will follow."

The final permit was at once granted by your Honor, and, upon the receipt of this permit by the Sanitary Trustees, at 11:15 o'clock A. M. of said day, the great bear trap dam was lowered and the water turned into the valley of the Desplaines River, thus consummating the long looked for event by the people of the Sanitary District of Chicago; and your Commission sincerely hopes that the desired relief anticipated by her people will be fully realized, and that the continuous flow through the channel of the amount of water regulated by law will meet the sanitary requirements contemplated by the Act of 1889, and prove satisfactory to the citizens of the Desplaines and Illinois River Valleys.

CONCLUSION.

In conclusion we desire to express to your Honor our deep appreciation for your earnest interest in the work of our Commission, for the able assistance and timely advice given us at all times in our deliberations and for the zeal manifested that the work and our conclusions should meet, not only the requirements of the law, but the approval both of the people of the city of Chicago and the Illinois Valley. We desire to congratulate your Honor upon the successful completion and opening of the channel during your administration, and we fully believe that the connecting of the water of the lakes with this channel is the first and important step looking to the building of a great commercial

waterway by the way of the Illinois and Mississipi Rivers, connecting the chain of great lakes on the north with the Gulf of Mexico on the south. Then will be realized the fondest hope of a great people, and the commonwealth of Illinois will contain the largest ship canal in the world, benefiting not only the people of our own State of Illinois, but the whole west and southwest.

The thanks of your Commission are also due to the Sanitary Trustees for their uniform courtesy and their willingness to aid your Commission in the duties required of them under the law.

We desire to extend to our Chief Engineer, Mr. Desmond FitzGerald, our thanks, and express our appreciation for his distinguished service in solving the intricate engineering problems which presented themselves, involving questions of the greatest importance to his profession. Mr. FitzGerald's report on the engineering features is appended and made part of this report. We also desire to express our thanks to the assistants for their untiring efforts in faithfully discharging the duties assigned to them.

Respectfully submitted,

Isaac Taylor

Jno Lamback

A. F. Bench

Special Commissioners,
Chicago Drainage Channel.

BEAR TRAP DAM—DOWN-STREAM SIDE.

CHIEF ENGINEER'S REPORT.

CHICAGO, ILL., December 1st, 1899.

COLONEL ISAAC TAYLOR,

President Special Commissioners, Chicago Drainage Channel.

Dear Sir:—Herewith please find a report on the engineering features connected with the investigation of your Commission.

PRELIMINARY.

On June 8th, 1899, I had the honor of receiving the appointment of Engineer to your Commission, and proceeded at once with the necessary surveys and investigations. From that time to the present the work has been advanced, as speedily as possible, and, considering the large amount of ground covered and the complexity of many of the questions involved, it is believed that excellent progress has been made. This progress has been very much expedited by the kindness of all the officials connected with the Sanitary District, and my thanks are particularly due to the President of the Board of Trustees, William Boldenweck, Esq., and Isham Randolph, Esq., Chief Engineer, for placing at my disposal all of the valuable records of the Board in every department and for assisting the investigation in every way in their power. One of the first duties devolving upon your Engineer was to make a thorough study of the provisions of the Act under which the Sanitary District works have been constructed in consultation with your Board and Attorney. The Act is printed in full in Appendix A to this report, together with a brief index to the principal features covered by the work of your Commission for the use of those who do not care to study all of the provisions of the Act.

INSTRUCTIONS.

The following instructions to guide your Engineer in his investigations were issued by your Commission, and this report is a direct answer, as far as possible, to these instructions. Sufficient material only has been added to make the answers as clear as possible.

"By the provisions of Section 20 of the Act under which the Sanitary District of Chicago is organized, the Chicago Drainage Channel is to be 'of sufficient size and capacity to produce a continuous flow of water of at least two hundred cubic feet per minute for each one thousand of the population of the district drained thereby' * * * * 'and said district shall, at the time any sewage turned into or through any such channel or channels, turn into such channel or channels not less than 20,000 cubic feet of water per minute for every 100,000 inhabitants of said district, and shall thereafter maintain the flow of such quantity of water.'

"Section 23 of the same Act provides: 'Such channel shall be constructed of sufficient size and capacity to produce and maintain, at all times, a continuous flow of not less than 300,000 cubic feet of water per minute, and to be of a depth of not less than fourteen feet, and a current not exceeding three miles per hour; and if any portion of any such channel shall be cut through a territory with a rocky stratum, where such rocky stratum is above a grade sufficient to produce a depth of water from Lake Michigan of not less than eighteen feet, such portion of said channel shall have double the flowing capacity above provided for, and a width of not less than 160 feet at the bottom capable of producing a depth of not less than eighteen feet of water.'

"You will make such survey and examination of said channel as will enable you to determine and report whether the above

rovisions of the Act have been complied with, and, if not, in hat respect there is a failure so to do.

"Your survey and examination will be based on the datum stablished by the Commissioners of the Illinois and Michigan anal in 1847.

"Said Section 23 also provides that 'in case a channel is onstructed in the Desplaines River as contemplated in this section, it shall be carried down the slope between Lockport and Joliet to the pool commonly known as the upper basin, of sufficient width and depth to carry off the water the channel shall bring down from above.' You will also make an examination and survey, if necessary, of this portion of the channel, and ascertain if the foregoing provisions of the law have been complied with, and, if not, in what respect there has been failure. In this examination, the amount of the natural flow of the Desplaines River should be taken into consideration so far as the capacity is concerned.

"You will also ascertain and report whether all bridges built across the said channel are so constructed as 'not necessarily' to 'interfere with or obstruct the navigation of such channel when the same becomes a navigable stream.'

"You will also make such surveys or examinations of the Chicago River and its branches as will enable you to determine and report to this Board the velocity of the current in the river with a flow of 300,000 cubic feet per minute delivered to the Drainage Channel; also the velocity of the current in the river arising from a flow of 20,000 cubic feet of water per minute for each 100,000 population of the Sanitary District; also the capacity of the Chicago River based on a current of one and one-quarter miles per hour in the average section of the river from Lake Michigan to Robey Street; also the capacity of the Chicago River with a current of one and one-quarter miles per hour in the average section of the river between Eighteenth Street and Halsted Street.

"In connection with the above, you will also report whether any other channels exist which can be connected as feeders with the said Drainage Channel, together with their capacities.

"You will also ascertain and report what provision, if any, has been made for the removal of all garbage, dead animals and parts thereof, and other solids, before any sewage shall be discharged into such channel, and whether such provisions, if any, are adequate to accomplish such purpose.

"You will determine, as accurately as possible from existing public data, the present population of the Sanitary District of Chicago, and report the same to this Board."

BRIEF DESCRIPTION OF THE WORKS OF THE SANITARY DISTRICT.

The City of Chicago is situated on a level plain only a few feet above the surface of Lake Michigan. It is separated into several divisions by the Chicago River, which flows through the City in two branches, connecting with the main part of the river a short distance westerly from its mouth at the lake. The river is a sluggish stream, rising and falling with the lake, and has no current in its normal condition. It receives the sewage of a large part of the City and the effluents from the stock yards, and is consequently an elongated septic tank, filled with decomposing organic matter. The river is more or less crowded with shipping throughout its length, and is crossed by numerous drawbridges.

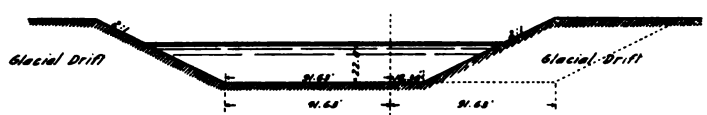
Close on the westerly borders of the City lies the Desplaines River, which flows from the north, and after reaching the latitude of the south central portion of the City turns to the southwest, joining the Illinois River, which in turn empties into the Mississippi. Owing to the extremely low divide separating the Desplaines River from Lake Michigan, in times of heavy freshets the river overflows its banks and passes into the Chicago River, sending a vast amount of polluting matter far out into the lake

SECTIONS OF CHICAGO DRAINAGE CHANNEL.

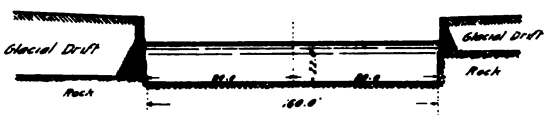
TOTAL LENGTH 28.05 MILES.

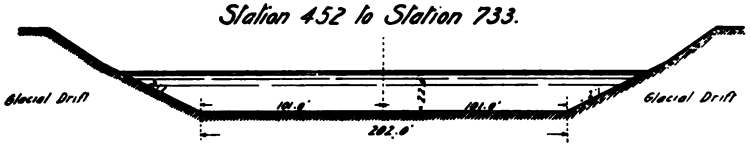
100 50 25 0 100 FT.

Station 45 to Station 450.

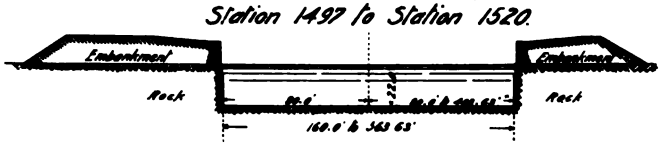


Sections from Station 737 to end of Channel.



Station 452 to Station 733.

Ordinary Rock Section.

Special Section

Special Section at Controlling Works. Station 1497 to Station 1520.

to the cribs which form the inlets of the public water supply of the City. It is this overflow from the six hundred or more square miles of the Desplaines water shed which gave the Chicago River its original width and depth, and has aided in maintaining them notwithstanding the constant deposits of sludge from the sewers.

It will be seen that by cutting through this low divide the sewage in the Chicago River can be made to flow into the Desplaines, and this, in fact, is exactly what has been rendered possible by the construction of the Chicago Drainage Channel. In addition to reversing the flow in the Chicago River and carrying the sewage of the City, diluted with water from Lake Michigan, into the Desplaines, an important part of the plan was the creating of a link in a deep water navigable channel from the great lakes to the Mississippi.

The Chicago Drainage Channel is a deep and wide channel extending southwesterly down the valley of the Desplaines River, from a connection with the South Branch of the Chicago River, in the City of Chicago, to Lockport, a distance of twenty-eight miles. At the outlet of the channel are situated the controlling works, a series of gates and a bear trap dam, for the regulation of the water in the channel. These works are thirty-four miles distant from Lake Michigan, the source of supply, by way of Chicago River and the Drainage Channel.

After the water is discharged at Lockport it will join the Desplaines River, and the united waters will pass down the valley, which is quite steep in this portion, in new and comparatively narrow channels to the lower pool at Joliet, where the works of the Sanitary District end, at a point about forty miles from the lake.

The valley of the Desplaines was once a wide, pre-glacial stream, and is now covered with drift of various depths. The Drainage Channel has been excavated through the drift

and the Niagara limestone, either partially or wholly, according as the rock approaches the surface. (See Profile Plate I.) The width of the channel in the rock is 160 feet, with vertical sides or nearly so, and providing for a depth of twenty-two feet when the water is flowing. In earth excavation the sides of the channel are sloped. The total fall of the channel is 5.65 feet. The different sections are all shown on Plate II.

In connection with the Desplaines River, it has been planned to shut off the overflow into the Chicago River, and for this purpose the Sanitary District has constructed embankments and a dam at the "Summit," thus keeping the whole of the flow of the river within its own channel. Embankments or levees have also been built to separate the river from the Drainage Channel, and in several cases a new bed has been excavated to take the entire flow of the river. This portion of the work of the Sanitary District is included under the head of the "Diversion of the Desplaines River." At present, the diverting dam at "Summit," which is in the form of a spillway 400 feet in length, has not been carried up to a sufficient height to divert all the water of the spring freshets; but it is the intention of the Sanitary District, as soon as the works at Joliet are completed, to raise the level of the overflow to the full height of the embankments.

In order to provide sufficient area in Chicago River when the flow is reversed, the Sanitary District has dredged the bottom and widened the channel in certain restricted portions and built by-passes, as indicated on Plate IV.

The channel immediately below the controlling works at Lockport is called the "tail race." A short distance below the "tail race" the channel is joined by the Desplaines River, and the mingled waters will be carried down the new channel for about a mile to the old bed of the river. After passing down the old bed of the river for about two and one-quarter miles the

waters will be collected into a new channel at Joliet, which terminates near the centre of the city in the upper pool, which is closed by a dam built diagonally across the channel. This dam is to be used for water power and replaces an old one which was used for the same purpose. After passing over the dam or through the gates and wheels, the water will again flow through the old bed of the river, which has been widened and deepened, to the lower pool at Joliet, about five and three-quarters miles below the controlling works.

The lengths of the several portions of the combined channels through which the water will pass from Lake Michigan to the lower pool at Joliet, are as follows:

	Feet.	Miles.
Chicago River	31,700	6.00
Chicago Drainage Channel	148,110	28.05
Tail race and 600-foot channel	5,400	1.02
Old river channel (undisturbed)	12,100	2.29
New river channel to dam at Joliet	7,278	1.38
Regulated river channel below the dam, ending in "lower pool," Joliet	5,280	1.00
Total	209,868	39.74

The Desplaines valley, in addition to the Drainage Channel and the river, contains two lines of railroad and the old Illinois and Michigan Canal. The latter is close to the course of the Drainage Channel. The old canal is a shallow excavation compared with the new channel, but it has for a number of years played an important part in the plans for the drainage of the City of Chicago, arising from the fact that it has been used to convey from 30,000 to 40,000 cubic feet per minute of Chicago River sewage from Bridgeport to Lockport, this amount being raised by pumps from the level of the river to that of the canal.

From the foregoing it may be seen that Lake Michigan is the beginning of this proposed drainage system and that it forms the reservoir from which the water starts. As the lake

fluctuates, so must the water in the river and channel change. The slope of the water, however, is to be regulated as far as possible by the gates at the terminus of the canal, which will be opened sufficiently to let out the water required by law. This amount is to be proportioned to the number of inhabitants of the Sanitary District on the basis of 20,000 cubic feet per minute for each 100,000 population of the Sanitary District. The law also provides that the depth shall be not less than fourteen feet in earth and eighteen feet in rock.

The works of the Sanitary District therefore cover four important sections:

First. The deepening and widening of the Chicago River from its mouth to Robey Street, a distance of exactly six miles.

Second. The construction of the Chicago Drainage Channel proper from Robey Street at Bridgeport to Lockport on the Desplaines River, a distance of 28.05 miles, including the controlling works at Lockport.

Third. The diversion of the Desplaines River, with new channels and levees separating it from the Drainage Channel.

Fourth. The tail race and new river channels, from Lockport to Joliet.

In addition to the foregoing, the Sanitary District has an interest in the Thirty-ninth Street sewer, a conduit twenty feet in diameter, now under construction, which, in addition to its function as an intercepting sewer, is intended to connect Lake Michigan with the South Fork of Chicago River, near the Stock Yards. An agreement has been made between the City of Chicago and the Sanitary District, under which the latter is to erect and maintain a pumping plant on the shores of the lake for the purpose of increasing the flow in this conduit to keep pace with the dilution of the sewage required by law as the population of the district increases.

For further descriptive notes, with quantities of materials, see Appendix B.

POPULATION.

The present population of the Sanitary District has been determined as accurately as possible from existing public data, and is herewith submitted in accordance with the request of your Commission.

CITY OF CHICAGO.

The boundaries of the Sanitary District (see Appendix D, and Plate V, Appendix D), include nearly the whole of the City of Chicago, together with an additional area lying to the west of the City, comprising portions of the towns of Lyons and Cicero, which contained a population of 26,568 in 1898. On the north, the portions of the City not included in the Sanitary District are two small districts known as "Rogers Park and West Ridge" and "Norwood Park," with a combined population of 4,670 in 1898. On the south, the line of the Sanitary District cuts off all that portion of the City lying south of Eighty-seventh Street, containing a population of 76,790 in 1898.

In order to ascertain the present population of the Sanitary District, it was thought best first to determine the population of the City of Chicago. (For table of Annexations and Areas, see Appendix D.)

For the purpose of the investigation, the three great natural divisions, commonly known as the North, South and West Divisions, were selected for separate study. In a general way, the North Division comprises that portion of the City lying north of the North Branch; the South Division that portion of the City lying south of the South Branch, and the West Division that portion of the City lying between the North and South Branches of the Chicago River.

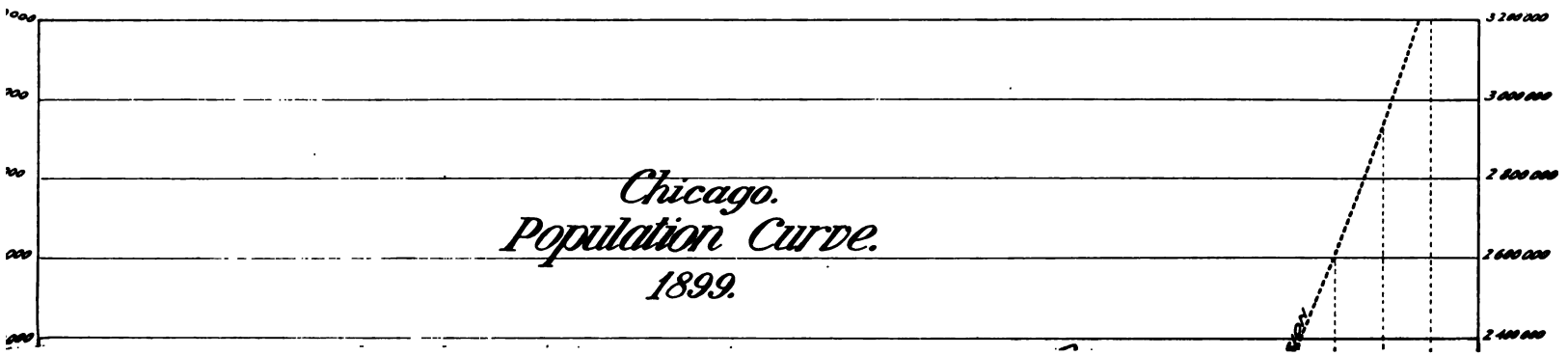
The population of each of these divisions was then carefully examined, collated and tabulated from the United States and School Census returns. In regard to the accuracy of the United

States Census, taken every tenth year, there can be practically no question. The School Census returns in Chicago, taken every second year, include a full count of the population of all ages, so that, if properly made, they should give a correct return of the total population, and, as a rule, they have been made with a close approximation to accuracy. In a number of cases there has been exaggeration, but it is not difficult, when all the returns are plotted in the form of curves, to determine the proper corrections to apply. The figures finally adopted in this report have been, in almost every case, less than those given by School Census, but a notable exception should be made in the case of the School Census of 1896.

Each of the three great divisions of Chicago was then farther divided into as many small "geographical districts" as possible (Plate D, Appendix D). These districts were carefully selected in the following manner: Tracings were made of the ward limits of the City through the changes of the different municipal administrations, and by placing these tracings one over the other, it became possible to select areas, comprising as few wards as possible, which had remained identical in their boundaries for many years, even though some of their interior ward lines had changed from time to time. As a rule, the limits of these geographical districts were traced from 1860 to the present time, although the tables only show the results from 1870 to 1898.

After the geographical districts were selected, Tables 1, 2 and 3 (Appendix E) were prepared. These tables show the population of the three great divisions, one on each sheet, separated into their respective geographical districts, and as minor divisions into wards or parts of wards. In some cases it became necessary to cut the wards into two or more portions, and the population of these portions was ascertained from the returns of the school precincts, which follow the lines of the voting precincts in the wards.

PLATE III.


3 200 000
3 000 000
2 800 000
2 600 000
2 400 000
Chicago.
Population Curve.
1899.

The totals for each district show on one horizontal line the progressive population for that district through the period covered by the examination, and the summary at the bottom of each table gives in united form the various geographical districts comprising each great division of the City.

After these tables were obtained, three diagrams (Plates VI, VII and VIII, Appendix E,) were prepared, showing the population curves for each division with its geographical districts. These diagrams facilitated the determination of the probable accuracy of the census returns. The accepted form of the curves, as finally adopted, is shown in dotted lines for each district. These curves, as a rule, pass through the points established from the United States Census returns. The combined ordinates of these separate curves give the ordinates for the curves of the whole of the division.

After these diagrams were completed for the three great divisions of the City, they in turn were combined into one population curve for the whole of Chicago (Plate III). This curve has been extended as far as 1907, showing the probable growth of the City in the immediate future. Upon this plate the large circles show the returns by the United States Census and the smaller circles the returns by the School Census. It will be noticed that the curve, as a rule, falls below the School Census returns.

The following brief summary, taken from the diagrams, gives the population of the whole of the City, by divisions, for the years 1898, 1899 and 1900:

TABLE SHOWING THE POPULATION OF THE ENTIRE CITY OF CHICAGO.

	1898.	1899.	1900.
North Division	322,000	341,000	362,000
South Division	666,000	715,000	767,000
West Division	825,000	870,000	920,000
Total	1,813,000	1,926,000	2,049,000

The population for 1898, by the School Census, was 1,851,588, to be compared with 1,813,000 from the preceding table.

An endeavor has been made to follow conservative rules in all questions of doubt, and it is confidently believed, as a result of the foregoing methods of investigation, that there can be no serious error in the results, and that the population of the City has been found from all of the public data available with trustworthy accuracy. In every case it is somewhat less than the actual counts taken by law, and which might be accepted as reasonably accurate returns.

Before proceeding with the determination of the population of the Sanitary District, it may not be amiss to call attention to the fact that the diagram promises a population of 3,000,000 for Chicago about the year 1907, provided the present rate of growth continues.

SANITARY DISTRICT.

Having found the population of the City of Chicago to be 1,926,000 in 1899, as a result of the foregoing study, the next step taken was to ascertain the population of the Sanitary District.

The population of the whole City is to be reduced on account of the areas outside of the Sanitary District, which, for 1898, are as follows:

North Division—"Rogers Park and West Ridge"	4,670
South Division—In the Thirty-first Ward	6,674
In the Thirty-third Ward	32,521
In the Thirty-fourth Ward	31,788
West Division—"Norwood Park"	1,137
Total	76,790

and allowing the proper percentage of growth for one year to bring this result to 1899, we have a total population of 81,574 to be deducted.

The population to be added to that of the City on account of areas outside of the City limits, but included in the Sanitary

District, is 28,135, all within the limits of the towns of Lyons and Cicero.

The difference between these two amounts is 53,439, which is to be subtracted from the total population of the City of Chicago, leaving 1,872,561 as the population of the Sanitary District for the year 1899. This estimate was reduced 72,561 in order to make the estimate a conservative one, and all computations for capacities founded on population have been made on the basis of 1,800,000, in round numbers, as the present population of the Sanitary District.

CHICAGO DATUM.

The Sanitary District Act provides that "The said Commission shall take as the datum line for their survey the datum established by the Illinois and Michigan Canal Trustees in 1847." This level has always been taken as the low water mark of Lake Michigan.*

The instructions of your Board, in accordance with legal advice, provided that all the computations made in the course of this investigation should be based upon the above height for the permanent level of the water in Lake Michigan. It is, therefore, a matter of some importance to ascertain what the datum is that was established by the Trustees of the Illinois and Michigan Canal in 1847.

The datum known as "Chicago datum" is supposed to represent the above level, but I cannot find that there is any real authority other than that of usage for assuming that it was established by the Trustees of the Illinois and Michigan Canal in 1847. The records in the Canal Office do not show that any datum was established by the Trustees in 1847, neither do the State records of Illinois, nor the City records of Chicago show any legal establishment of a datum in 1847.

* In 1895, however, the lake receded to a level 1.01 feet lower than in 1847.

The first report and plan for sewerage of the City of Chicago, by Mr. E. S. Chesbrough, December 1, 1855, contains the following words:

"With regard to the outlets of the sewers, it is proposed to place them so that the bottom of the interior surface of the mains will be six inches below the present surface of the lake, or eighteen inches above low water level of 1847, and to place the bottom of the two-foot sewers six inches higher, or about the level of the present surface of the lake.

"As the lake, unaffected by winds, was, in 1838, twenty-four inches higher than the proposed outlets of the two-feet sewers, these would then be full, and the five-foot mains half full."

The above, however, throws almost no light on the question of the datum of 1847, except that it shows the low water level of 1847 was adopted at about this time. Many investigations have already been made by others on the question of the establishment of Chicago datum, and a paper and discussion on the subject may be found in the last "Journal of the Western Society of Civil Engineers," but nothing satisfactory has yet been evolved.

The precise levels of the Sanitary District start from a bench established on the sill of the Canal Collector's Office at Bridgeport, with the elevation 9.441. This bench was established in 1882 by Francis Murphy, C. E., from the coping of the old lock in the Illinois and Michigan Canal at Ashland Avenue. The lock contained several benches, one of which was marked 11.12, and is the one which Mr. Murphy transferred to the sill of the Collector's Office before the destruction of this portion of the lock. (See Appendix C.)

The lock was built in 1847, and tradition has connected its construction with the low water of that year. One of the walls of the lock, with the exception of the coping and the upper courses, is still standing at Bridgeport.

This wall is beveled, starting from a level which is approximately Chicago datum, and it has been maintained that this bevel was in some way connected with the low water mark

of 1847; also that the floor and mitre sill of this old lock were used as benches. The mitre sill and the floor have, however, been removed, and nothing now remains connected with the foundation of the wall except some timber, which probably extends under the wall, and is now cut off a short distance outside of its face.

General Wilson's survey of the Illinois River was made in 1867, and it seemed probable that if his level note books could be found they might throw some light upon the bench on the old lock, which was assumed to be 11.12 in 1883, especially as the principal engineers of the canal were also General Wilson's assistants. I am indebted to Major William L. Marshall, United States Engineer, for the finding of the original note book, which contains the most reliable information so far brought to light in regard to this bench.

The levels were apparently started in 1867 from this bench, and the following is a reproduction of the notes as they appear in the book:

"O=Upper surface of lower level of Chicago lock, Illinois and Michigan Canal."

"B. M. on right lower hollowquoin coping stone, 16.861."

The levels were then carried on for a short distance with this bench and abandoned, and then follows this note:

"17 June, 1867.

"Upon consulting the records of the Illinois and Michigan Canal, obtained from Mr. Carter, Assistant Engineer, it was found that their datum line is 0.439 lower than the measurements obtained from the lock keeper, this last plane being, as per records of the company, 6.00 below the lowest water known in Lake Michigan for a period of thirty years. The levels above should therefore be corrected in profiling so as to bear reference to the datum plane, thus finally adopted." *

Then follows, under the same date, the following:

"17.477—Ill. & M. B. M. on bolt in lower left hand hollowquoin coping, datum 6.00 below lowest water in the lake for thirty years."

"17.300 U. S. B. M. on right hand lower hollowquoin coping lower gate, same datum."

* These last three words are in the original note book in pencil, but were omitted in the copy made in ink.

After connecting the two benches, which were found to check with each other exactly, the level notes then began with this height of 17.300, thus agreeing with the finished profile which was found in the United States Engineer's office, and which farther bears the following words: "Initial point of the survey at the Bridgeport lock."

It becomes evident from the above notes that the height of this bench, by the old canal levels, was 16.861, and that the datum was lowered 0.439, making the height of the bench 17.300. The canal engineers planned to make their canal six feet deep at low water; so if six feet be deducted from 17.300, to refer to the lowest water in the lake, we have 11.300 for the true height of the bench above datum. How this bench in 1883 could have been given a value of 11.12, thus raising the datum 0.18 feet is a mystery, but from the above there is no doubt that what is known as Chicago datum is substantially the low water that was accepted in 1847 as the lowest water known in Lake Michigan for a period of thirty years, but it is doubtful whether there was ever any formal establishment of that level by the Trustees of the Illinois and Michigan Canal.

I have had a number of levels taken on the bevel existing in the old lock, and the average gives an elevation of –0.394, with reference to Chicago datum. Levels taken under my direction on the top of the old wooden planking, under the lock wall, show an average height of –7.12, and, allowing 0.02 for the penetration of the pointed rod in the wood, we have –7.10 for the corrected level.

An analysis of the foregoing data has led me to formulate the following theory of the establishment of Chicago datum:

When the engineers of the Illinois and Michigan Canal started to build their lock at the Chicago River, in 1847, they found that the water was lower by 0.439 feet than the level before accepted as the lowest level of Lake Michigan. This lowest level was in February, 1847, just before the working

season opened. They therefore lowered their datum, which was six feet below the lowest level of the lake, by the above amount, and thus, without any formal action on the part of the Trustees, practically established, by the levels adopted in the construction of the lock, the low water level of 1847.

It now remains to be seen how the different levels which have been taken confirm the above theory. The difference in height between the two benches found by General Wilson on the coping, in 1867, was exactly 0.18 feet, which is the difference between the height of the bench transferred to the canal office, in 1883, by Mr. Murphy, and the height of the United States bench, found in 1867, by General Wilson. If a mistake was made by some one in holding the rod on the wrong bench, viz: the one near the left hand hollowquoin, and giving it a value of 17.30, then the right hand bench would have a value of 17.12 or 11.12, as found engraved by Mr. Murphy, and as a result, if this is true, Chicago datum, as now accepted, is 0.18 feet higher than originally established.

A fairly good chain of circumstantial evidence seems to bear out this assumption.

Mr. Ossian Guthrie, who saw the lock built, says that the mitre sill was placed on the floor of the lock, and that it was of smoothly hewn timber, 11 inches thick, or 0.92 feet, and that there was a platform of 12-inch roughly hewn timber, 8 feet wide, in front of it, to protect the sill from boats entering the lock.

The level of the floor was found to be –7.10, referred to present datum, and, if the latter was 0.18 feet too high, then this distance would be –6.92 to true datum, and deducting 0.92 for the mitre sill, we have its top surface exactly 6 feet below low water, or the 0.00 of the last system of levels adopted in 1847, by which the elevation of the right hand hollowquoin coping bench was made, 17.300.

If this kind of reasoning is correct, we may therefore tabulate the levels as follows:

	Old Datum.	Old Datum 6.00 Feet to Refer to Low Water.
Mitre Sill of Old Lock	0.0	-6.00
Bevel of Old Lock	5.786	-0.214*
Low Water of 1847	6.000	0.000
Bench on Coping	17.300	11.300

From the above investigations it appears that Chicago datum, as now used, represents the low water of 1847, as established informally under the direction of the Trustees of the Illinois and Michigan Canal, with a probable error of 0.18 feet, which is sufficiently near for all practical purposes. Chicago datum is now so universally used and so firmly fixed that it would not be changed as a plane of reference at this late day, even if it could be clearly proved to be 0.18 feet higher than originally intended.

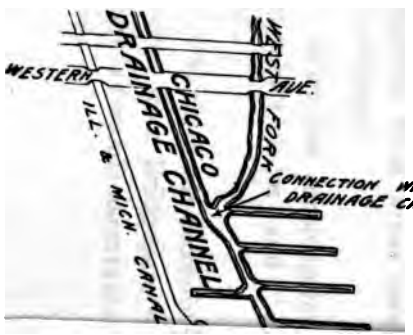
All of the levels taken by the Sanitary District have been referred to Chicago datum, and they have been established from benches determined with the greatest care by modern precise level methods.

CAPACITY OF CHICAGO RIVER.

The Chicago River at present is a sluggish stream without current except in times of freshet, or when the Desplaines River overflows its banks and finds its way into Lake Michigan by way of the South Fork. It forms the connecting link between the Drainage Channel and the lake (see Plate IV). As the effect of the opening of the gates at the controlling works will be to reverse the current in Chicago River, there are but two ways to estimate the capacity of the river under the new conditions:

* It seems reasonable to assume that while it was probably the intention of the Canal Engineers to place this bevel at low water, its exact position would be governed by the courses of masonry.

PLAN OF CHICAGO RIVER SHOWING CONNECTION WITH THE CHICAGO DRAINAGE CHANNEL. 1899.



one by computations founded on purely theoretical considerations, in which judgment and experience contribute largely towards the result, and the other by making use of some value for the frictional resistances already measured in a determination of slopes and velocities.

Since this investigation was begun no opportunity has been afforded for measuring the discharge and slope of the river, as the stream has been practically devoid of current. Fortunately, several valuable measurements were made by Mr. Thomas T. Johnston, C. E., on May 6, 7 and 8, 1892, when a very large freshet was discharging from the Desplaines River into Lake Michigan via Chicago River. The slope of the stream was carefully measured, and the flow computed from float observations.

From these data, the values of "n" in Kutter's formula and of "c" in Chezy's formula were computed, and by careful comparison with the new hydraulic conditions when the flow is reversed and Chicago River made to discharge into the Chicago Drainage Channel, a very fair idea may be formed of the frictional resistances to be expected under the new conditions.

When the great freshet of May 6, 7 and 8, 1892, occurred, the Engineers of the Sanitary District were engaged upon a complete hydrographic survey of the river, which was not completed until some time later. The mean radii were therefore computed from areas taken from old soundings made by the Government.

After due consideration, it was thought best to recompute the values of "n" and "c," referring them to the survey of 1892.

The river was accordingly divided into several stretches or reaches from Bridgeport to the lake, and the values of "n" in Kutter's formula ascertained for these different portions of the river.

While the above work was in progress, cross-sections were made from soundings taken from the channel at Robey Street to Twelfth Street, which was as far as the dredging of the river by the Sanitary District had progressed. A comparison was then made between the sections of the river below Twelfth Street, made from the Sanitary District survey of 1892, with that made in 1896 and 1898 under the direction of Major William L. Marshall, United States Engineer, and it appeared that the Government soundings gave about 9 per cent. more area. It was also found from actual soundings that they represented very closely the present condition of the river from Twelfth Street to the terminus of the South Pier in Lake Michigan. The Government soundings were therefore used in estimating the capacity of the river below Twelfth Street when the flow is reversed.

The next step was to ascertain the slope of the surface and the velocities of the current in Chicago River, with a flow of 300,000 cubic feet per minute from Lake Michigan to the Drainage Channel, this being the minimum flow stipulated in the law; and also with a flow of 20,000 cubic feet per minute to each 100,000 of the population of the Sanitary District, the flow required on the basis of population, or 360,000 cubic feet per minute, using for the values of "n" in Kutter's formula the values ascertained for each particular reach in the river as before described.

The following is a brief description of the reaches: The first extends from the end of the South Pier to Lake Street, a distance of 7,113 feet; the second from Lake Street to Harrison Street, a distance of 4,228 feet; the third from Harrison Street to Twelfth Street, a distance of 2,650 feet; the fourth from Twelfth Street to Eighteenth Street, a distance of 4,138 feet; the fifth from Eighteenth Street to Halsted Street, a distance of 4,746 feet; the sixth from Halsted Street to Main Street, a distance of 3,267 feet, and the seventh from Main Street to

Robey Street, the junction of the Chicago Drainage Channel, a distance of 5,580 feet.

The values of "n" in these different stretches of the river varied from 0.043 to 0.060. With a flow of 300,000 cubic feet per minute, it was found that the average velocity of the current in the average cross-section of the stream, for its whole length, will be 1.08 miles per hour, and in the narrowest stretch of the river, from Eighteenth Street to Halsted Street, the average velocity of the current will be 1.31 miles per hour.

With a flow of 360,000 cubic feet per minute, it was found that the average velocity of the current in the average cross-section of the river throughout its length will be 1.33 miles per hour, and in the narrowest reach of the river, from Eighteenth Street to Halsted Street, the average velocity of the current will be 1.63 miles per hour.

The capacity of Chicago River, based on an average current of 1¼ miles per hour in the average section of the whole length of the river, is about 340,000 cubic feet per minute, and the capacity of Chicago River, with an average current of 1¼ miles per hour in the narrowest reach of the river, between Eighteenth and Halsted Streets, is about 290,000 cubic feet per minute.

In these computations the abnormal sections of the river, such as those existing at the drawbridges or in a few very wide sections of the river, were omitted.

The foregoing estimates do not take into consideration the results of any extraordinary obstructions in the river, such as formation of ice sheets, large masses of floating ice, or a crowded condition of shipping. The formation of ice sheets in the river is now prevented by tugs, which break up the ice as fast as it is formed, in order to keep navigation open during the winter.

From an investigation, made under my direction, into the number of vessels present in the river when the great freshet of May 5, 6, 7 and 8 was measured, it appears that there were about thirty vessels distributed along the docks between Polk and Nineteenth Streets, and that the remainder of the seventy-five vessels, confined in the South Branch of the Chicago River during that freshet, were lying inside the limits of the slips, and therefore formed no obstruction to the outflowing water. During this freshet there were also about fourteen large steamers in the South Branch, tied up at the docks, averaging fourteen feet draft and thirty-five feet beam. An investigation of the movements of the vessels during the freshet shows that on May 5 a few vessels were taken out and a few towed in, probably not more than twenty-five altogether; on May 6 about seventeen vessels were towed into the river and only one or two taken out; on May 7 about sixteen vessels were towed in and only two or three towed out, and on May 8 the number moved probably exceeded fifty, the majority of these being towed down the river into Lake Michigan.

Whatever obstruction these vessels offered to the flow of the current during the freshet was measured and allowed for in the frictional resistences represented by the values of "n" in the Kutter formula, as already described.

Should the river, however, contain at any time a larger number of vessels, it is obvious that the velocity of the current will exceed the figures already given. It is possible that some system may be devised by which a concentration of vessels in the river will be avoided.

It is believed, however, in view of the probabilities of unusual obstructions from boats and ice, and the fact that average velocities only have been considered, that the estimates of velocities and capacities above given are based on a favorable rather than an unfavorable point of view. (For Tables of Tonnage and Movement of Vessels, see Appendix F.)

RECAPITULATION.

The following table contains a summary of the foregoing results:

Cubic Feet per Minute.	Average Velocity in Total Length of River.	Average Velocity Eighteenth to Halsted Streets.
290,000	.... miles per hour.	1.25 miles per hour.
300,000	1.08 " "	1.31 " "
340,000	1.25 " "	.... " "
360,000	1.33 " "	1.63 " "

TOTAL FALL IN CHICAGO RIVER.

With a flow in Chicago River of 300,000 cubic feet per minute, the total fall from Lake Michigan to Robey Street, the beginning of the Drainage Channel, computed by the method already described, is 1.73 feet. With a flow of 360,000 cubic feet per minute, the total fall at Robey Street is 2.995 feet, or, in round numbers, three feet.

In considering the discharge of the Chicago Drainage Channel, these falls are taken as initial stages of the water at the beginning of the channel.

CAPACITY OF THE CHICAGO DRAINAGE CHANNEL.

As this channel is not yet completed, and has never had a flow of water between its banks, and as the channel itself is of very great size, it is obvious that if its capacity is to be estimated in advance, it must be done by some theoretical method. In order to throw some light upon the possible discharge of the channel, all the available experiments and measurements heretofore made in channels of large capacity were collected in the following table:

TABLE OF HYDRAULIC ELEMENTS AND DEDUCTIONS FROM GAUGINGS OF VARIOUS CHANNELS.

For Use in the Ganguillet and Kutter Formula.

$$V=\frac{a+\frac{1}{n}+\frac{m}{s}}{1+\left(a+\frac{m}{s}\right)\frac{n}{\sqrt{R}}}\sqrt{RS}=C\sqrt{RS}$$

V=Mean Velocity
R=Mean Hydraulic Radius
S=Sine of Slope
n=Coefficient of Roughness

a=41.66
1= 1.811
m= .00281

Description of Channel, Authority, &c.	R	C	S	n	v
Artificial channel of the Desplaines River opposite Gary, Ill. Straight and fairly level across. About 200 wide on bottom.—From Jour. West. Soc. C. E., 1896	7.82	79.92	.0000796	.029	.....
	7.20	72.70	.0000707	.029	.....
Irwadi River at Saiktha, Burmah.—Quoted by Kutter from Gordon, 1873	21.13	105.90	.0000344	.029	2.857
	22.97	103.60	.0000387	.029	3.091
Solani Embankment, 15th mile, new site, earth channel side slopes 1½:1.—Quoted by Kutter from Cunningham, Roorkee, 1880	8.35	92.80	.0002200	.023	3.980
Same, old site, side slopes 2½ to 1	8.64	89.10	.0002310	.024	3.980
Linth Canal at Grynau. Trapezoidal earth channel.—From Kutter	9.18	94.90	.0003700	.022	5.530
Seine at Poissy.—Quoted by Kutter	17.87	91.10	.0000750	.029	3.330
Rhine at Germersheim. Gravel and fine detritus. Quoted by Kutter from Grebenau, 1867	17.27	78.70	.0003490	.030	6.101
Rhine at Byland. Reach over 11 miles.—Quoted by Kutter from Krayenhoff, 1812	16.45	89.20	.0000977	.029	3.575
Bayou Plaquemine.—Quoted by Kutter from C. Ellet, 1851	18.35	84.50	.0002064	.030	5.198
Same	15.32	84.40	.0001437	.029	3.959
Sacramento River at Freeport, Cal.—From the Report of the Commissioner of Public Works of California for 1894. Measurements made with current meter in 1879	23.45	95.62	.0000744	.029	3.994
	23.99	95.73	.0000786	.029	4.157
	23.92	98.90	.0000675	.029	3.974
	23.54	79.05	.0000778	.037	3.383
	19.93	84.68	.0000580	.034	2.879
Northern Canal, Lowell, Mass. Dry stone walls.—Hiram F. Mills, 1899	12.96	122.63	.0000209	.022	2.020
	13.35	104.26	.0000417	.025	2.460
	13.30	100.31	.0000642	.025	2.931
Illinois and Michigan Canal. Trapezoidal earth channel.—Desmond FitzGerald, 1899	6.13	97.30	.0000249	.023	1.204
Mississippi River.—From Report of Mississippi River Commission, 1882; measurements in 1881:					
At Clayton, Ia., August 22	13.74	85.79	.0000250	.034	1.590
" " " 29	14.32	85.55	.0000280	.034	1.713
" " June 14	19.85	82.37	.0000688	.034	3.044
At Hannibal, Mo., August 16	16.50	104.12	.0000240	.029	2.072
" " September 9	16.47	111.29	.0000260	.026	2.305
" " " 13	17.50	77.25	.0000730	.036	2.761
At St. Louis, Mo., January 12	14.57	55.04	.0001294	.049	2.390
" " " 14	14.17	53.87	.0001231	.050	2.250
" " " 25	13.49	64.10	.0000971	.041	2.320
" " " 31	13.16	70.75	.0000889	.036	2.420
" " February 2	13.21	81.11	.0000702	.031	2.470
" " May 27, slough	8.40	57.21	.0001811	.040	2.230
" " June 6, "	5.69	57.44	.0000767	.037	1.200

This table contains results of several measurements not heretofore included in such compilations, but believed to be of more than ordinary value. Among them are several measurements made under my direction of the capacity of the Illinois and Michigan Canal. This canal starts from the Chicago River at Bridgeport, and parallels the Chicago Drainage Channel throughout its course. Its dimensions are much smaller than those of the Drainage Channel, but as the excavations were made in material of the same character, it was thought that the results would be of value. A preliminary experiment was made by passing the concentrated sewage, which forms the flow in the canal, through small pipes alternated with flow of clear water to ascertain whether the sewage was subject to different frictional resistances from clear water, and these experiments showed that no allowances were to be made on this account. The slope of the canal was so flat that it was only arrived at by precise levels and over a stretch of seven miles.

In addition to the foregoing, a measurement was made, especially for this investigation, of the Northern Canal, Lowell, the largest canal connected with the "Locks and Canals." The experiments were conducted under the direction of Hiram F. Mills, Esq., the eminent hydraulic engineer for the "Proprietors of Locks and Canals on the Merrimac River."

The Northern Canal is 100 feet wide, and has a depth of about 17 feet, and contains a straight stretch of 800 feet. Gauges were established on both sides of the canal with observers at each gauge, who took readings with needle-point gauges every minute for forty-five minutes, and readings of fixed gauges on every intermediate half minute. The observers changed places, and observed in the same way for the next forty-five minutes, in order to balance any personal errors. The measurements of the velocity were made by floats, and the fall in the canal due to the resistances of the bed was determined with

accuracy. It is believed the results are a valuable addition to the table.

The capacity of a channel, such as the one under consideration, may be ascertained in the absence of direct measurement from two standpoints: First, from the most favorable possible assumption for the resistances due to friction; and, secondly, from the most unfavorable assumption for the resistances, with the strong probability that the actual capacity will fall somewhere between these limits, but will not exceed them in either direction. All of the computations connected with the channel have been made from both of these standpoints, and, where necessary for a clear understanding of any portion of the problem, both results are given.

The slope of the channel through the glacial drift is one in 40,000, and through the rock portions one in 20,000. The total fall from Robey Street to the controlling works is 5.65 feet. The elevation of the bottom of the channel at Robey Street is –24.45, and at the outlet –30.1, referred to Chicago datum.

The actual cross-sections of the channel were ascertained by survey. A small engineering force for this purpose was organized early in the investigation and placed under the charge of Mr. William B. Ewing, C. E. The areas found from this survey were used in the computations. The banks of the channel in the earth sections are caving badly, but the alterations in form have not yet materially affected the capacity.

The channel has not been constructed of full width in the portion nearest Chicago River. The narrowest portion, excavated in the earth, is 141,110 feet in length and extends from Station 38+89.7 (Robey Street) to Station 450. At Station 450 the channel has been widened to the full width and continues for a distance of 28,580 feet to Station 735+8, where the rock sections begin. These sections have vertical sides and they extend to Station 1480, a distance of 74,420 feet; at Station 1480 the enlarged section at the controlling works begins and

extends to Station 1520. This section has a length of 4,000 feet. The whole length of the channel above described is 148,110.3 feet, or 28.05 miles.

Starting at Robey Street, with an elevation of the water of -3.00, referred to Chicago datum, and with a value of "n" of 0.031, which may be called an estimate from the unfavorable point of view, I find that the capacity of this narrow portion of the channel is 5,945 cubic feet per second, or 356,700 cubic feet per minute, which is practically 360,000 cubic feet per minute, the quantity required by law on the basis of population.

If the water will pass through this section without difficulty, it is evident it will pass through the larger sections.

We come next to the consideration of the capacity of the rock sections to pass 600,000 cubic feet per minute, as required by law.

In the rock sections a value for "n" of 0.025 was adopted, which gave a capacity of 11,311 cubic feet per second, or 678,660 cubic feet per minute, which shows that this portion of the channel is sufficiently large to carry the quantity required by law from the conservative point of view. Should the value of "n" be found to be as low as 0.018, after the channel is built, the capacity will be 14,705 cubic feet per second, or 882,300 cubic feet per minute; the average velocity in the latter case being 4.11 feet per second, or 2.8 miles per hour.

As the water in the channel will nowhere be less than 21.4 feet deep, the provisions of the law requiring a depth of not less than fourteen feet in the earth and eighteen feet in the rock, have been liberally complied with. A width of 160 feet for the bottom of the channel in rock excavation has also been provided, as required by law.

From the foregoing computations, it is evident that the Chicago Drainage Channel has a sufficient capacity, as an open and unobstructed channel, to pass the water, in accordance with the Act establishing the Sanitary District.

The question then arises: Are there any unfavorable conditions likely to occur which will affect the capacity of the channel to pass the amount of water required by law?

EFFECTS OF ICE.

If the surface of the water in a channel is allowed to freeze over, it is apparent that the resistance to the flow must be very much increased. To such a degree is the capacity of discharge reduced that it has often led to serious diminution in the power developed by canals for manufacturing and other purposes. There are, however, very few reliable measurements existing which throw any light upon the actual effect resulting from the presence of an ice sheet.

Some observations have been made on the Upper Mississippi River at Crow Wing, and on the Crow Wing River itself just above its junction with the Mississippi. Through the courtesy of the United States Engineer's Office at St. Paul, the results of these measurements have been placed at my disposal. While the experiments are not as complete as could be desired, the general result is to show that with a heavy sheet of ice over the surface the flow was diminished about 66 per cent., and on the Crow Wing River was diminished through the same cause about 48 per cent. These measurements tend in a general way to confirm the results of practical observations on water power canals in the northern part of the United States.

After consideration, it was decided to compute the discharge of the Chicago Drainage Channel on the basis of an assumed value for the resistance in the wetted perimeter due to the under side of an ice sheet. Some investigations into the possible thickness of ice on the channel showed that there is a strong probability that in very severe winters, if the ice is allowed to accumulate, it may reach a depth of 22 inches. In the computations it was assumed that there would be a displacement of 20 inches of water. In the narrow earth sections covered with

an ice sheet giving 20 inches of displacement, and with a value of "n" in Kutter's formula of 0.020, the discharge was found to be 4,436 cubic feet per second, or 266,160 cubic feet per minute; with a more unfavorable assumption for the resistances, or a value of "n" in Kutter's formula of 0.031, the discharge will be reduced to 2,981 cubic feet per second, or 178,860 cubic feet per minute. That is to say, with this unfavorable view of the frictional resistances, about one-half the quantity required by law would go under the ice sheet.

In the wide earth channel, with a favorable assumption for the frictional resistances, or with a value of "n" in Kutter's formula of 0.019, the discharge is 9,075 cubic feet per second, or 544,500 cubic feet per minute, and with a more unfavorable assumption for the frictional resistances, or a value of "n" in Kutter's formula of 0.031, the discharge is 5,878 cubic feet per second, or 352,680 cubic feet per minute.

In the rock sections, with a favorable assumption for the frictional resistances, or a value of "n" in Kutter's formula of 0.019, the discharge is found to be 8,408 cubic feet per second, or 504,480 cubic feet per minute; with a more unfavorable assumption for the frictional resistances, or a value of "n" in Kutter's formula of 0.025, the discharge is found to be 6,614 cubic feet per second, or 396,840 cubic feet per minute.

It will be seen from the above that if the surface of the Chicago Drainage Channel is allowed to freeze over to the extent assumed, the capacity of the channel will be reduced far below the requirements of the law.

OTHER FEEDERS.

Your instructions ask whether any other channels exist which can be connected as feeders with the Chicago Drainage Channel.

The City of Chicago is now engaged in the construction of a very large conduit, twenty feet in diameter, known as the

Thirty-ninth Street Tunnel, which is to act as an intercepting sewer for the collection of the sewage now discharged into Lake Michigan from a considerable portion of the South Division of the City.

This conduit extends in an easterly and westerly direction through Thirty-ninth Street, and is planned to connect the lake with the South Fork of the Chicago River, near the Stock Yards.

The whole length of the Thirty-ninth Street Tunnel is 12,070 feet, of which 10,000 feet are to be constructed as a tunnel, under air pressure, and 2,070 feet, at the westerly end, in open cut. The latter portion is nearly completed, but of the tunnel a length of about 1.5 miles still remains to be built. It is expected that, at the present rate of progress, this conduit will be completed during the year 1901, but whatever the rate of progress may be, it will evidently be some time before it can be put into service to reinforce the Chicago River as a feeder to the Drainage Channel.

The capacity of the Thirty-ninth Street Tunnel has been computed as follows:

With a fall of three feet in the level of Chicago River at Robey Street, when a flow of 360,000 cubic feet per minute is passing through the South Branch of Chicago River, and with a value of "n" of 0.015 in the Kutter formula, the capacity will be 85,164 cubic feet per minute.

With a fall of 1.73 at Robey Street, due to a flow of 300,000 cubic feet per minute in the Chicago River, the capacity of the Thirty-ninth Street Tunnel will be 65,088 cubic feet per minute.

To discharge 120,000 cubic feet per minute, which has been estimated as the maximum capacity of the tunnel, will require a head of 6.37 feet, which can only be secured by means of pumps, which it is proposed to erect at the easterly end, near the lake. By an agreement between the City of Chicago and

the Sanitary District, the latter is to erect and maintain the pumping plant. The building of the conduit is undertaken by the City.

There is now no channel existing other than the Chicago River which can act as a feeder for the Drainage Channel, and the above Thirty-ninth Street conduit is the only other channel provided which can be considered as a probable feeder in the immediate future.

DESPLAINES RIVER.

The instructions of your Board require an investigation of the safe passage of the water from the controlling works, at Lockport, to the upper pool at Joliet, including the natural flow of the Desplaines River. Supplementary instructions have also required me to include the question of any possible obstructions to the safe passage of the water from the upper pool down the river. The proposed diversion of the whole flood discharge of the Desplaines River, by the raising of the overflow at the Summit, as heretofore described, and the works of the Sanitary District in connection with this diversion being also closely connected with these subjects, it has been thought best to treat them all together under the head of "Desplaines River."

Provision is now being made by the Sanitary District for discharging 25,000 cubic feet per second at Joliet, of which 13,000 cubic feet per second are to pass over the dam, now nearly completed across the upper pool, and the remainder, 12,000 cubic feet per second, through gates which it is proposed to build in connection with the tail race on the side of the channel. The Sanitary District has not yet received from the Electric Light and Power Company the completed plans for the portion of the work connected with the discharge into the tail race, but I am informed that there is no other open spillway than the dam, which is 272 feet in length. Where the freshet flow of a river is computed on a narrow margin of safety, it is usual to make provision for taking the whole of the flow of the river over the top

of the dam, on the theory that gates and machinery for operating them may not be in working order in times of emergency. The discharge of 25,000 cubic feet per second over the Joliet dam would necessitate a depth of about ten feet above the crest and six feet depth for 13,000 cubic feet per second, as proposed by the Sanitary District, the remainder being taken through the gates. The propriety of building a fixed dam across a narrow channel in a position like that at Joliet, from an engineering point of view, may well be questioned; the position of the dam, however, and its height, were fixed by a decree of court. In view of these facts, I have suggested that spillways should be built in the wall, which is to be erected on the side of the channel in connection with the development of the water power, and that these spillways should have a capacity of 12,000 cubic feet per second.

Of the maximum flow of 25,000 cubic feet per second, for which provision has been made at Joliet, it may be assumed that 10,000 cubic feet per second will be furnished by the Chicago Drainage Channel, as the law provides for a continuous flow, leaving 15,000 cubic feet per second to be contributed by the Desplaines River.

The question of the probable maximum freshet yield of the river is an extremely important one. It is only within the last twenty-five years that any records have been kept that throw much light upon the maximum freshet flow, and during this interval at least two floods have occurred, which indicate a yield of 13,500 cubic feet per second at Riverside, where the water-shed of the Desplaines River has an area of 633 square miles.

In this interval several other freshets have been recorded which approximate the above amount, and it may well be a subject for serious inquiry whether there may not be a very much larger run-off in the future.

A flow of 13,500 cubic feet per second from 633 square miles of water-shed is equivalent to 0.79 inches in depth in twenty-four

hours collected from the water-shed, or 21.25 cubic feet per second per square mile.

In an inquiry into possible freshet flow, the ordinary catchment basin formulæ prove of comparatively little value, and dependence must be placed upon a study of the rainfall and other conditions connected with the freshets that have been observed in the past, and upon the exercise of judgment and experience to aid in forming a conception of probable maximum freshet flows in the future.

The average rainfall in Chicago is probably about 36 inches* yearly, subject to great variation, probably from 23 to 53 inches. The monthly averages are as follows : January, 2.20; February, 2.34; March, 2.56; April, 3.20; May, 3.82; June, 3.78; July, 3.82; August, 3.01 ; September, 2.90 ; October, 3.41 ; November, 2.74; December, 2.25.

In September, 1894, the total rain for the month amounted to 8.21 inches, of which 7.13 inches fell in a week, during which the maximum rainfall for twenty-four hours was 3.35 inches from 8:00 P. M. of the 3rd to 8:00 P. M. of the 4th.

The great freshets which have occurred in the Desplaines River in recent years have been those of April 21, 1881; February 9, 1887; May 6, 1892, and June 25, 1892.

The freshet of 1881 was the result of the gradual melting of a large amount of snow which had been accumulating upon the ground during the winter, and was not aided by any considerable rain; in fact, the rainfall for the whole month was only 1.84 inches. This freshet extended through several weeks, during which time the height of the river was at its maximum for four days.

The freshet of 1887 culminated after a rainfall of less than two inches, and the other freshets mentioned occurred during the early summer.

*From the United States Weather Bureau.

The largest amount of run-off may naturally be expected in the spring, when the ground is still frozen, and perhaps covered with an accumulation of snow. Should a warm, heavy rain occur at such a time, it is evident that the freshet flow must be very large.

An inspection of the following tables from the records of the United States Weather Bureau will show that rainfalls of more than two inches in twenty-four hours are rare during the months of December, January, February and March, although there is a record of one rainfall of between 3 and 4 inches occurring during the month of March in the interval covered by the table from 1871 to 1899. It is worthy of notice, however, that during the month of April there have been nine rainfalls of from 1 to 1½ inches in twenty-four hours; seven from 1½ to 2 inches, and one from 2 to 3 inches.

TABLE NO. 1—MAXIMUM RAINFALLS.

U. S. WEATHER BUREAU, CHICAGO.

(Greatest in 24 consecutive hours.)

	JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
1871	1.20	.78	.71	2.41	1.03	2.57	1.57	.73	.53	1.41	1.24	2.50
1872	.26	.42	1.88	.71	.96	1.21	1.14	.89	2.70	.45	.77	.04
1873	.81	.23	.26	1.66	2.82	.57	1.35	.58	1.94	1.73	.54	1.21
1874	1.04	.57	1.20	1.45	.64	1.45	.43	2.19	1.28	1.56	.79	.31
1875	.58	.65	.36	1.03	1.10	1.70	2.29	1.22	3.44	1.49	.35	.66
1876	1.53	1.94	1.67	1.51	.79	1.87	1.91	1.82	1.72	.44	.93	.14
1877	1.02	.06	.91	.68	.73	2.65	1.47	1.26	1.19	2.55	1.66	1.02
1878	.72	.76	1.50	1.55	1.66	1.87	4.14	1.36	1.16	1.41	.22	.69
1879	.41	.36	.87	1.48	2.52	1.02	3.25	.16	.40	1.43	1.50	1.10
1880	.95	1.17	1.15	1.65	1.26	1.17	.84	1.25	.89	1.91	.45	.45
1881	.24	1.34	1.04	.86	.68	2.57	1.81	.30	1.10	1.29	3.35	1.14
1882	.49	1.35	1.43	1.58	1.77	1.92	1.00	1.69	.63	1.17	.45	.81
1883	.60	1.94	.18	1.38	2.37	1.20	1.77	1.05	.68	1.94	3.39	.52
1884	.39	1.13	3.26	1.74	.68	.64	1.46	1.27	1.09	1.39	.87	.95
1885	1.24	.99	.20	1.71	1.23	3.44*	.83	6.19†	1.65	2.22	1.17	1.29
1886	.71	.53	.54	.42	.52	.58	.61	1.39	2.11	.59	.74	.37
1887	1.39	1.23	.48	.18	.49	.70	.45	1.24	1.33	.82	.66	1.04
1888	.51	.76	1.01	.90	2.43	.97	1.29	1.00	.45	1.31	1.10	.98
1889	.68	.44	.93	1.03	1.42	.68	4.02	.16	2.08	.82	1.47	.95
1890	.94	.53	.60	.90	2.60	1.03	1.31	1.47	.98	1.16	.84	.47
1891	1.25	1.25	.58	1.48	.84	.79	1.28	1.92	.20	.21	.84	.56
1892	.57	.42	.59	.70	1.66‡	3.11§	1.41	.61	.82	.78	1.43	.86
1893	.60	.87	.55	1.32	.91	1.46	1.14	.16	.95	.80	.91	.81
1894	.64	1.02	1.11	1.37	1.01	.63	.53	.25	3.35	.34	.43	1.01
1895	.91	.91	.73	.38	.57	.60	.86	3.65	.58	.38	1.77	2.66
1896	.58	1.52	.30	1.18	1.47	.92	1.81	1.24	2.42	.92	.57	.06
1897	1.24	.45	1.00	.54	.45	2.01	.37	.83	.43	.18	.85	.56
1898	1.13	1.05	1.84	.43	.52	2.50	1.22	.89	1.20	.86	1.20	.42
1899	.24	.98	.67	.06	.92	.67	....	....	....	....	....	....

* June 2d and 3d. † August 2d and 3d. ‡ May 5th. § June 23d and 24th.

11.28" total for month of August, 1885, largest total for one month, 1871 to 1899.

TABLE NO. 2—MAXIMUM RAINFALLS.

Showing total number of days in each month, from 1871 to 1899, in which precipitation was as follows:

PRECIPITATION.	JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
Less than .01"	101	105	105	99	78	64	56	55	57	53	73	127
.01" to .10"	188	167	179	154	152	125	101	99	105	121	145	203
.11" to .25"	65	63	77	69	61	67	50	57	52	53	69	50
.26" to .50"	54	46	56	46	55	61	40	37	39	39	46	40
.51" to 1"	21	27	25	36	54	50	45	29	30	39	36	22
1" to 2"	8	10	10	16	15	15	17	17	14	13	9	10
2" to 3"	....	....	....	1	4	5	1	1	4	2	....	2
3" to 4"	....	....	1	....	....	2	1	1	2	....	2	....
Over 4"	....	....	....	....	....	....	2	1	....	....	....	....

On the following dates the rainfall exceeded two inches in twenty-four hours:

March 25 and 26, 1884....3.26"
April 10, 1871....2.41"
May 1 and 2, 1873....2.82"
May 25, 1879....2.52"
May 27 and 28, 1888....2.43"
May 9 and 10, 1890....2.60"
June 22 and 23, 1871....2.57"
June 25 and 26, 1877....2.65"
June 6 and 7, 1881....2.57"
June 2 and 3, 1885....3.44"
June 23 and 24, 1892....3.11"
June 16 and 17, 1897....2.01"
June 25, 1898....2.50"
July 27 and 28, 1875....2.29"
July 25 and 26, 1878....4.14"
July 6 and 7, 1879....3.25"
July 27, 1889....4.02"
August 21 and 22, 1872....2.19"
August 2 and 3, 1885....6.19"
August 23 and 24, 1895....3.65"
September 28 and 29, 1872....2.70"
September 9, 1875....3.44"
September 9 and 10, 1886....2.11"
September 4 and 5, 1889....2.08"
September 3 and 4, 1894....3.35"
September 14, 1896....2.42"
October 19 and 20, 1877....2.55"
October 19, 1885....2.22"
November 11 and 12, 1881....3.35"
November 5 and 6, 1883....3.39"
December 23, 1871....2.50"
December 18 and 19, 1895....2.66"

While it is undoubtedly true that in Chicago heavy rains are less likely to occur in the winter and spring than in other parts of the year, yet heavy rainfalls may be expected during the winter, as is shown by the fact that 5.92 inches fell in December, 1895, during the week just preceding Christmas.*

The Desplaines water-shed is comparatively devoid of timber, and may be described as a thickly populated farm district, which is favorable to a rapid collection of a large percentage of rainfall.

The freshet of June, 1892, was actually measured, so that there can be no question about the accuracy of the estimated collection of 0.79 of an inch in twenty-four hours, and I cannot escape the strong conviction that a very much larger freshet than this may result from the combination of a warm rain in

* See Proceedings of Western Engineers, Vol. 1, No. 3, page 305.

the winter with an accumulation of snow on the ground. The exact nature of the damages that may result from such a condition of affairs no one can state with any degree of certainty, but in view of the large loss of property and life which may result from a freshet of great magnitude, it would seem to be the part of wisdom to make a more careful study of the whole subject than has been possible in this report. Perhaps it may be practicable to provide for a cut-off or diversion of a portion of the Desplaines water-shed to Lake Michigan, which, in fact, has been proposed by Lyman E. Cooley, C. E., and others.

From the best accessible data, it appears that the area of the Desplaines water-shed at Lockport is 767 square miles, and at the upper pool at Joliet 789 square miles. A collection of 0.79 of an inch in twenty-four hours on 789 square miles will produce a freshet of 16,766 cubic feet per second, provided the collection is proportioned to the area of the water-shed, which is about the same amount as has been allowed by the Sanitary District.

Should a very much larger flow than this take place, the provision for waste at the dam at Joliet would prove entirely insufficient, and the water would rise high enough to flood certain portions of the city, and it seems possible that a freshet might occur which would not pass down the channels provided in the diversions in the Desplaines River, especially if accompanied by serious ice jams, in which event the Chicago Drainage Channel might be overflowed and the Chicago River made to discharge into the lake.

Some idea of the effect of ice gorges upon a river in connection with a large freshet may be formed by a consideration of the great flood in the Chicago River in 1849, when it appears that "Every vessel and canal boat in the South Branch, except a few which had been secured in one or two little creeks which then connected with the main channel, was torn from its moorings and carried with the flood. Light vessels were crushed

like egg-shells, and canal boats would disappear and come up below in small pieces. * * * Many of the wharves and some of the bridges over the South Branch of the Chicago River and on the river from the South Branch to the lake were carried away, including the bridges at Bridgeport and a bridge across the canal. The bridges at Madison, Randolph and Wells Streets resisted for only a moment, and were then carried away by the flood."

The above is compiled from Moses and Kirkland's History of Chicago, A. T. Andreas' History of Chicago, and the files of the Daily Democrat and the Journal, newspapers published in 1849 (see Appendix G).

GARBAGE.

You have asked me to report "What provision, if any, has been made for the removal of all garbage, dead animals and parts thereof, and other solids, before any sewage shall be discharged into the Drainage Channel."

No provision has been made, that I can discover, for the removal of all garbage, dead animals and parts thereof, and other solids, before any sewage shall be discharged into the Chicago Drainage Channel.

BRIDGES.

I am requested to "Ascertain and report whether all bridges built across the said channel are so constructed as not necessarily to interfere with or obstruct the navigation of such channel when the same becomes a navigable stream."

A large number of bridges have been built by the Sanitary District both across the Chicago Drainage Channel and the Chicago and Desplaines Rivers.

The bridges have been generally designed either of the bascule or swing type, and advantage has been taken of the provisions in the statute by which the bridges "may be operated as fixed bridges for a period of seven years from and after

the time when the water has been turned into the channel, unless the needs of general navigation sooner require them to be operated as movable bridges." They have not been provided with the necessary machinery for operating them as movable bridges. The Sanitary District, however, is under contract with the railroad companies to furnish this machinery whenever it becomes necessary.

In some cases the Sanitary District is obliged to maintain the bridges, and in others a capitalized sum has already been paid to the railroads to cover maintenance, operation and accident.

The bridges in my opinion will "not necessarily" interfere with or obstruct the navigation of the Chicago Drainage Channel "when the same becomes a navigable stream."

In Appendix G will be found extracts from contracts which will give a clear idea of the basis on which the maintenance of the bridges has been fixed.

The following table contains a list of all the bridges:

BRIDGES CONNECTED WITH THE CHICAGO RIVER.

No.	Kind of Bridge.	Name.	Remarks.
1	Fixed—Highway.	Van Buren Street (over by-pass).	City ordinance. To be built by Sanitary District and maintained by City.
2	Bascule—Highway.	Taylor Street (over the River).	City ordinance. Sanitary District to build and City to maintain.
3	Bascule—Railroad.	Chicago Terminal Transfer Railroad Co. (over the River).	Contract with Railroad Company. Sanitary District to build and Railroad Company to maintain.
4	Bascule—Highway.	Canal Street (over the River).	City ordinance, which provides that any cost over $35,000 is to be paid by Sanitary District, and City to maintain.

BRIDGES OVER CHICAGO DRAINAGE CHANNEL.

No.	Kind of Bridge.	Name.	Remarks.
1	Swing—Double Roadway.	Southwest Boulev'd and Western Avenue.	Joint contract with City and West Park Commissioners. Sanitary District to build, maintain and equip with rotating mechanism.
2	Movable—Railroad.	Pennsylvania Railroad, Southwest Division (4 tracks), Chicago Terminal Transfer Railroad (2 tracks), Chicago Junction Railway (2 tracks).	Separate contract with each company. Sanitary District to build and pay capitalized sum to railroads for maintenance.
3	Swing—Railroad.	Illinois Cent'l Railroad (formerly Chi'go, Madison & Northern Railroad).	Contract with Railroad. Built by Sanitary District which is to pay a capitalized sum for maintenance, and when operated as a swing bridge to be equipped with rotating machinery and interlocking signal devices at expense of Sanitary District.
4	Swing—Highway.	Kedzie Avenue.	No contract. Built by Sanitary District and to be maintained by them.
5	Swing—Railroad.	Atchison, Topeka & Santa Fe. Twenty-sixth Street.	Built by Sanitary District under contract with Railroad Company. Capitalized sum to be paid by Sanitary District for maintenance.
6	Swing—Railroad. (4 track)	Chicago & Western Indiana and Belt Railroad.	Contract with Railroad. Built by Sanitary District and capitalized sum to be paid by said District for maintenance.
7	Swing—Railroad.	Atchison, Topeka & Santa Fe (Le Moyne Bridge).	Built under contract with Railroad and capitalized sum to be paid by Sanitary District for maintenance.
8	Swing—Highway.	Summit and Lyons.	Built under contract under ordinance of Village of Summit by which it is to be maintained by Sanitary District.
9	Swing—Railroad.	Chicago Term. Transfer Railroad.	Built by Sanitary District under contract by which a capitalized sum is to be paid by Sanitary District for maintenance.
10	Swing—Highway.	Willow Springs Highway Bridge.	No contract or ordinance can be found to cover the construction of this bridge but it is understood that the Sanitary District is to equip, maintain and operate it.
11	Swing—Railroad.	Atchison, Topeka & Santa Fe (Lemont Bridge).	Built under contract with Railroad by which Sanitary District is to pay a capitalized sum for maintenance.
12	Swing—Highway.	Lemont, Stevens Street.	No contract or ordinance can be found to cover the construction but it is understood that the Sanitary District is to equip, maintain and operate the bridge.
13	Swing—Highway.	Romeo Highway Bridge.	Built under ordinance which commits the Sanitary District to its construction and maintenance.

IN ADDITION TO ABOVE BRIDGES OVER THE CHICAGO DRAINAGE CHANNEL THERE ARE TWO RAILROAD BRIDGES OVER HIGHWAYS.

1	Fixed—Railroad.	Illinois Cent'l Railroad (formerly Chi'go, Madison & Northern), over Kedzie Avenue.	Built under contract by which Sanitary District is to build, and to pay a capitalized sum for maintenance.
2	Fixed—Railroad.	Atchison, Topeka & Santa Fe Railroad (over Stevens Street, Lemont).	Built by Sanitary District under verbal agreement by which the railroad is to maintain it.

BRIDGES CONNECTED WITH THE DESPLAINES RIVER.

No.	Kind of Bridge.	Name.	Remarks.
1	Fixed—Railroad.	Atchison, Topeka & Santa Fe Railroad (No. 5).	Built jointly by Railroad Company and Sanitary District. The latter is to pay a capitalized sum for maintenance of one-half the bridge.
2	Fixed—Highway.	Summit and Lyons Road.	Built under ordinance. The cost of maintenance is not paid by the Sanitary District.
3	Lengthening of Railroad Bridge.	Chicago Term. Transfer Railroad.	Built under contract by which Sanitary District is to pay a capitalized sum for maintenance.
4	Fixed—Railroad.	Atchison, Topeka & Santa Fe Railroad (at Lemont).	Built under contract by which Sanitary District is to pay one-half the cost of construction and a capitalized sum for maintenance of one-half the bridge.
	THE FOLLOWING BRIDGES ARE BELOW THE CONTROLLING WORKS:		
5	Fixed—Highway.	Lockport Road (3 200-foot spans.	Built under contract with Highway Commissioners by which Sanitary District is to build and the Highway District to maintain it.
6	Fixed—Highway.	Wire Mills Road (just below Lockport).	Built under contract with Highway Commissioners by which Sanitary District is to build and the Highway District to maintain it.
7	Fixed—Railroad.	Elgin, Joliet & Eastern Railroad (just above City of Joliet).	Built by Sanitary District under contract with Railroad Company by which the Railroad Company is to maintain it.
8	Tow Path.	At junction of new channel with the Illinois and Michigan Canal.	Built under decree of Court, by which Sanitary District is obliged to build and maintain it.
9	Fixed—Highway.	Cass Street, Joliet.	Built by Sanitary District under two city ordinances and to be maintained by the City of Joliet.
10	Fixed—Highway.	Jefferson Street, Joliet.	Built under two city ordinances by which Sanitary District is to build and the City of Joliet to maintain it.
11	Extension of Railroad Bridge.	Chicago, Rock Island & Pacific Railway.	Built under contract by which Sanitary District is obliged to build and to pay a capitalized sum for cost of maintenance.

RECAPITULATION.

The following contains a recapitulation of the most important of the conclusions embodied in the foregoing report:

1. The present population (1899) of Chicago is 1,926,000, and of the Sanitary District 1,800,000, and on the basis of 20,000 cubic feet of water per minute for each 100,000 inhabitants of the Sanitary District, the present capacity of the Chicago Drainage Channel (1899) should be 360,000 cubic feet of water per minute.

2. While there is no evidence of any formal establishment of datum by the Commissioners of the Illinois and Michigan Canal in 1847, still there is sufficient evidence existing to prove that Chicago datum as now accepted is certainly not more than 0.18 of a foot higher than the level of the datum used by the canal engineers in building the old lock at Chicago River from which the benches were taken. Therefore, Chicago datum as now established may be accepted as the datum plane representing low water of 1847.

3. The capacity of the Chicago River, with a fall of 2.995 feet at Robey Street and unobstructed by ice, is 360,000 cubic feet per minute, and with a fall of 1.73 feet at Robey Street the capacity is 300,000 cubic feet per minute. In the former case, the average velocity in the average cross-section of the stream for its whole length will be 1.33 miles per hour, and taking the narrowest reach of the river, between Eighteenth Street and Halsted Street, the average velocity will be 1.63 miles per hour. With a flow of 300,000 cubic feet per minute, the average velocity in the average cross-section of the stream for its whole length will be 1.08 miles per hour, and in the narrowest stretch of the river, from Eighteenth Street to Halsted Street, 1.31 miles per hour.

4. The capacity of the Chicago River, when free from ice, based on an average current of 1¼ miles per hour in the average

section of the whole length of the stream, is about 340,000 cubic feet per minute, and in the narrowest reach of the river, from Eighteenth Street to Halsted Street, about 290,000 cubic feet per minute.

5. The capacity of the Chicago Drainage Channel is sufficiently large to pass 356,700 cubic feet per minute through the earth sections, or practically 360,000 cubic feet per minute, and with this amount flowing the average velocity will be 1.27 miles per hour. The capacity through the rock sections will be 678,660 cubic feet per minute, and the average velocity will be 2.15 miles per hour. If the channel is allowed to freeze over with a considerable depth of ice, the amount of water required by law will not pass under the ice sheet. There will be a much greater depth of water in all portions of the channel than is required by law, viz.: Fourteen feet in the earth and eighteen feet in the rock.

6. The Thirty-ninth Street Tunnel is the only other channel which can be connected with the Drainage Channel, and its capacity without pumping will be 85,165 cubic feet per minute.

7. On the basis of the largest freshet that has thus far been measured in the Desplaines River and neglecting the effects of ice, sufficient provision has been made for carrying the water from the Chicago Drainage Channel to the upper basin at Joliet, but provision should be made for overflows into the tail race connected with the dam at Joliet, and it is probable that larger freshets than any that have already been measured will occur in the future and probably cause great damage.

8. No provision has been made for the removal of garbage, dead animals and other solids from the sewage before it is discharged into the Chicago Drainage Channel.

9. The bridges built in connection with the Drainage Channel "will not necessarily interfere" with or restrict the navigation of the channel when it becomes a navigable stream.

This report has been based upon the work connected with the Sanitary District when completed in accordance with the plans submitted to your Board. Sufficient surveys have been made to make it evident that these plans have been and are now being carried out in good faith, and with the intention of completing them at the earliest possible moment. Much work, however, still remains to be done, a list of which has been furnished to your Board. The main Drainage Channel is nearly completed.

In conclusion, I desire to thank your Board for the support and kindly courtesy uniformly extended to me during these investigations, and to express my obligations to the staff of assistants who have aided me in the work.

Very respectfully,

Chief Engineer.

CANAL AS SEEN AT WILLOW SPRINGS, LOOKING WEST.

APPENDIX.

CURVE IN CHANNEL AT ROMEO, ILLINOIS.

APPENDIX A.

BRIEF INDEX.

For Dimensions ..... See Section 23
For Capacity ..... See Sections 20, 23, 25, 27
For Datum to be Used ..... See Section 27
For Bridges ..... See Section 12
For Garbage and Solids ..... See Section 20
For Inspection Commissioners ..... See Section 27

SANITARY DISTRICT ACT*

Together with an "Act for the Improvement of the Illinois and Desplaines Rivers," Also Act Conferring Police Powers, and Joint Resolutions of the Legislature.

AN ACT TO CREATE SANITARY DISTRICTS AND TO REMOVE OBSTRUCTIONS IN THE DESPLAINES AND ILLINOIS RIVERS, AND THE DAMS AT HENRY AND COPPERAS CREEK.

Passed May 29, 1889, in Force July 1, 1889, and Amendments Thereto.

SECTION.

1. Incorporating Sanitary District—Question, how submitted—Commissioners, etc.
2. Judicial Notice of District—Organization—County Judge.
3. Trustees—Election and Terms of.
4. Trustees Constitute a Board—Duties and Power of.
5. Ordinance Making Appropriation—Publication of.
6. Ordinances and Resolutions—Evidence.
7. Board of Trustees—Powers of.
8. May Purchase and Sell Real Estate.
9. May Borrow Money—Limitation.
10. To Provide for Direct Annual Tax—Net Earnings.
11. Contracts—How let.
12. Trustees May Levy and Collect Taxes—Bridges.
13. Expenses of Improvement—Special Assessments—General Tax.
14. Assessments—Installments—Interest.
15. When Assessments Payable by Installments—Bonds may be Issued.
16. Private Property—How Taken for Improvement.
17. May Acquire Right of Way.
18. Special Assessment—Damage to Property and Cost of Acquiring.
19. Liability of Sanitary District for Damages.
20. Capacity of Channel or Outlet.
21. Sanitary District—Failure to Comply with Act—Remedy—Penalty.
22. Act—How Construed.
23. Channel—How to be Constructed.
24. Channel—When Completed—Control of.
25. May Permit Territories Outside to Drain, etc.
26. When City or Village Owns Water Works, etc.
27. When Channel Constructed—Commissioners to Inspect its Work.

SANITARY DISTRICTS.

AN ACT to Create Sanitary Districts and to Remove Obstructions in the Desplaines and Illinois Rivers, and the Dams of Henry and Copperas Creek. Approved May 29, 1889. In force July 1, 1889, and amended by an Act in force July 1, 1895. Approved May 13, 1897. In force July 1, 1897.

¶ 1. [INCORPORATING SANITARY DISTRICT—QUESTION, HOW SUBMITTED—COMMISSIONERS.] § 1. *Be it enacted by the People of the State of Illinois, represented in the General Assembly,*

* From copy published by the Sanitary District.

That whenever any area of contiguous territory within the limits of a single county shall contain two or more incorporated cities, towns or villages, and shall be so situated that the maintenance of a common outlet for the drainage thereof will conduce to the preservation of the public health, the same may be incorporated as a sanitary district under this Act, in the manner following: Any 5,000 legal voters resident within the limits of such proposed sanitary district may petition the county judge of the county in which they reside to cause the question to be submitted to the legal voters of such proposed district whether they will organize as a sanitary district under this Act. Such petition shall be addressed to the county judge, and shall contain a definite description of the territory intended to be embraced in such district, and the name of such proposed sanitary district; *provided, however*, that no territory shall be included in any municipal corporation formed hereunder which is not situated within the limits of a city, incorporated town or village, or within three miles thereof, and no territory shall be included within more than one sanitary district under this Act. Upon the filing of such petition in the office of the county clerk of the county in which such territory is situated it shall be the duty of the county judge to call to his assistance two judges of the circuit court, and such judges shall constitute a board of commissioners which shall have power and authority to consider the boundaries of any such proposed sanitary district, whether the same shall be described in such petition or otherwise. Notice shall be given by such county judge of the time and place where such commissioners will meet, by a publication inserted in one or more daily papers published in such county, at least twenty days prior to such meeting. At such meeting the county judge shall preside, and all persons in such proposed sanitary district shall have an opportunity to be heard touching the location and boundary of such proposed district and make suggestions regarding the same, and such commissioners, after hearing statements, evidence and suggestions, shall fix and determine the limits and boundaries of such proposed district, and for that purpose and to that extent may alter and amend such petition. After such determination by said commissioners, or a majority of them, the county judge shall submit to the legal voters of the proposed sanitary district the question of the

organization and establishment of the proposed sanitary district, as determined by said commissioners, at an election to be held on the first Tuesday after the first Monday in November thence next ensuing. Notice whereof shall be given by said commissioners, at least twenty days prior thereto, by publication in one or more daily papers published within such proposed sanitary district, such notice to specify briefly the purpose of such election, with a description of such proposed district. Each legal voter resident within such proposed sanitary district shall have the right to cast a ballot at such election, with the words thereon, "for sanitary district," or, "against sanitary district." The ballots so cast shall be received, returned and canvassed in the same manner and by the same officers as is provided by law in the case of ballots cast by county officers. The county judge shall cause a statement of the result of such election to be spread upon the records of the county court. If a majority of the votes cast upon the question of the incorporation of the proposed sanitary district shall be in favor of the proposed sanitary district, such proposed district shall thenceforth be deemed an organized sanitary district under this Act.

The courts have held this Act to be constitutional upon the following grounds: (1) The General Assembly has power to authorize the creation of sanitary districts, regardless of the existence and boundaries of pre-existing municipal corporations, and to invest said sanitary districts with the power of general taxation. (2) These sanitary districts are not limited in the amount of their indebtedness by the amount of pre-existing indebtedness of other municipal corporations comprising the whole or part of the same territory. (Art. 9, Sec. 12, Const., 1870.) This Act is neither local or special legislation within the prohibition of Section 22, Article 4, Constitution, 1870. Wilson vs. Trustees Sanitary District, 133-443. Nor is this Act in violation of Article 3, or Section 13, Article 4 of the Constitution of 1870. People v. Nelson, 133-565.

Section 31, Article 4, Constitution of 1870, empowers the construction of drainage, etc., by special assessment. This does not prohibit the construction of the same by general taxation. Wilson v. Board of Trustees, 133-443.

This section does not violate Section 1, Article 7 of the Constitution, the accumulation of votes not being compulsory. People v. Nelson, 133-565.

Two Judges of the Circuit Court and also the County Judge are Commissioners *de facto*, at least, and their acts as such are valid. People v. Nelson, 133-565. Their duties as judges are not incompatible with their duties as commissioners. People v. Nelson, 133-565.

¶ 2. [JUDICIAL NOTICE OF DISTRICT ORGANIZATION—ELECTION—COUNTY JUDGE.] § 2. All courts in this State shall take judicial notice of the existence of all sanitary districts organized under this Act. Upon the organization of any sanitary district under this Act the county judge shall call an election to elect officers and cause notice thereof to be posted or published, and perform all other acts in reference to such election in like manner as nearly as may be, as he is required to perform in reference to the election of officers in newly organized cities under the provisions of an Act entitled "An Act to Provide for the Incorporation of Cities and Villages," Approved April 10, 1872.

¶ 3. [TRUSTEES, ELECTION AND TERMS OF.] § 3. In each sanitary district, organized under this Act, there shall be elected nine trustees who shall hold their offices for five years, and until their successors are elected and qualified, except the term of office of the first trustees elected, shall be until five years after the first Monday in December after their election. The election of trustees, after the first, shall be on the Tuesday next after the first Monday in November in every fifth year. In all elections for trustees each qualified voter may vote for as many candidates as there are trustees to be elected, or he may distribute his vote among not less than five-ninths of the candidates to be elected, giving to each of the candidates among whom he distributes the same the same number of votes or fractional parts of votes. The trustees shall choose one of their number president, and such sanitary district shall from the time of the first election held by it under this Act be construed in law and equity a body corporate and politic and by the name and style of the sanitary district of....., and by such name and style may sue and be sued, contract and be contracted with, acquire and hold real estate and personal property necessary for corporate purposes, and adopt a common seal and alter the same at pleasure.

This section does not violate Section 1, Article 7, of the Constitution, the accumulation of votes not being compulsory. People v. Nelson, 133-565.

¶ 4. [TRUSTEES CONSTITUTE A BOARD—DUTIES AND POWERS OF—DUTIES AND COMPENSATION OF OFFICERS—ORDINANCES.] § 4. The trustees elected in pursuance of the foregoing provisions of this Act shall constitute a board of trustees for the district by which they are elected, which board of trustees is hereby declared to be the corporate authorities of such sanitary district, and shall exercise all the powers and manage and control all the affairs and property of such district. Said board of trustees shall have the right to elect a clerk, treasurer, chief engineer and attorney for such municipality, who shall hold their respective offices during the pleasure of the board, and who shall give such bond as may be required by said board. Said board may prescribe the duties and fix the compensation of all the officers and employes of said sanitary district; *provided, however*, that the salary of the president of said board of trustees shall in no case exceed the sum of four thousand dollars per annum; and the salary of the other members of the board shall not exceed three thousand dollars per annum; *and, provided further*, that the amount received by any attorney shall not exceed the sum of five thousand dollars ($5,000) per annum. Said board of trustees shall have full power to pass all necessary ordinances, rules and regulations for the proper management and conduct of the business of said board of trustees and of said corporation, and for carrying into effect the objects for which such sanitary district is formed.

This section is not void; it is in accord with Article 4, Section 13, Constitution of 1870. People v. Nelson, 133-565.

¶ 5. [ORDINANCES, MAKING APPROPRIATION, PUBLICATION OF.] § 5. All ordinances making any appropriations shall, within one month after they have passed, be published at least once in a newspaper published in such district, or if no such newspaper of general circulation is published therein, by posting copies of the same in three public places in the district; and no such ordinance shall take effect until ten days after it is so published, and all other ordinances, orders and resolutions shall take effect from and after their passage unless otherwise provided therein.

¶ 6. [ORDINANCES AND RESOLUTIONS—EVIDENCE.] § 6. All ordinances, orders and resolutions, and the date of publication thereof, may be proven by the certificate of the clerk, under

the seal of the corporation, and when printed in book or pamphlet form, and purporting to be published by the board of trustees, and such book or pamphlet shall be received as evidence of the passage and legal publication of such ordinances, orders and resolutions, as of the dates mentioned in such book or pamphlet, in all courts and places without further proof.

¶ 7. [BOARD OF TRUSTEES, POWERS OF.] § 7. The board of trustees of any sanitary district organized under this Act shall have power to provide for the drainage of such district by laying out, establishing, constructing and maintaining one or more main channels, drains, ditches and outlets for carrying off and disposing of the drainage (including the sewage) of such district, together with such adjuncts and additions thereto as may be necessary or proper to cause such channels or outlets to accomplish the end for which they are designed in a satisfactory manner; also to make and establish docks adjacent to any navigable channel made under the provisions hereof for drainage purposes, and to lease, manage and control such docks, and also to control and dispose of any water power which may be incidentally created in the construction and use of said channels or outlets, but in no case shall said board have any power to control water after it passes beyond its channel, waterways, races or structures into a river or natural waterway or channel, or water power or docks situated on such river or natural waterway or channel; *provided, however*, nothing in this Act shall be construed to abridge or prevent the State from hereafter requiring a portion of the funds derived from such water power, dockage or wharfage to be paid into the State treasury to be used for State purposes. Such channels or outlets may extend outside of the territory included within such sanitary district and the rights and powers of said board of trustees over the portion of such channel or outlet lying outside of such district shall be the same as those vested in said board over that portion of such channels or outlets within the said district.

There may be no force whatever to the proviso in this section. People v. Nelson, 133-565.

If channels, drains, etc., are the subject of a condemnation proceeding, and the amount of land involved is claimed to be in excess of a reasonable amount, the land owners have the right to demand that the

plans and profiles of the proposed improvement be produced in court. Tedens v. Sanitary District, 149-87 (1894).

The district is empowered to condemn so much land as may reasonably be required and used to comply with the object contemplated by the Legislature when it passed the Act, but no right is given to take more land than reason would deem necessary for the construction, use and maintenance of the main channel, drains and outlets. Tedens v. Sanitary District, 149-87 (1894).

Under this section the district may, to a certain extent, determine for itself the quantity or amount of land to be taken and used for the channels, etc., but said right must be subordinate to all statutory or constitutional restrictions, and is further limited by the power of the State courts to prevent abuses. Tedens v. Sanitary District, 149-87 (1894).

The sewerage systems of incorporated cities within the sanitary district are not required by this Act to pass immediately under the control of the trustees of said sanitary district. But when the main channels are completed and, together with the adjuncts and additions thereto, they are so extended that the lands of the sanitary district are thereby drained, then these channels and the auxiliary drains may pass under the control of said Trustees for drainage purposes. Rich vs. City of Chicago, 152-18 (1894).

The object of this Act is to construct main channels through which all the drainage of the district may be discharged, and to bring the drainage of the district into such channels and, further, to construct the "adjuncts and additions" authorized by the Act, which are dependent upon the construction and completion of the main channels. Rich v. City of Chicago, 152-18 (1894).

¶ 8. [MAY PURCHASE AND SELL REAL ESTATE, ETC.] § 8. Such sanitary district may acquire by purchase, condemnation, or otherwise, any and all real and personal property, right of way and privilege, either within or without its corporate limits, that may be required for its corporate purposes; *provided*, all moneys for the purchase and condemnation of any property shall be paid before possession is taken, or any work done on the premises damaged by the construction of such channel or outlet, and in case of an appeal from the county court taken by either party, whereby the amount of damages is not finally determined, the amount of judgment in such court shall be deposited at some bank, to be designated by the judge thereof, subject to the payment of such damages on orders signed by such county judge, whenever the amount of damages is finally determined; and when not longer required for such

purposes to sell, convey, vacate and release the same, subject to the reservation contained in Section 7, relating to water powers and docks.

Districts acquire fee in all lands condemned. Allen v. Sanitary District of Chicago, Supreme Court, November 2, 1897.

¶ 9. [MAY BORROW MONEY — LIMITATION.] § 9. The corporation may borrow money for corporate purposes and may issue bonds therefor, but shall not become indebted in any manner, or for any purpose, to an amount in the aggregate to exceed five per centum of the valuation of taxable property therein, to be ascertained by the last assessment for State and county taxes previous to the incurring of such indebtedness; *provided, however*, that said five per centum shall not exceed the sum of fifteen million ($15,000,000) dollars.

¶ 10. [TO PROVIDE FOR DIRECT ANNUAL TAX—NET EARNINGS.] § 10. At the time, or before incurring any indebtedness, the board of trustees shall provide for the collection of a direct annual tax sufficient to pay the interest on such debt as it falls due, and also to pay and discharge the principal thereof as the same shall fall due, and at least within twenty years from the time of contracting the same; *provided*, that the net earnings from water power and docks may be appropriated and applied to the purpose of paying the interest or principal of such indebtedness, or both, and to the extent that they will suffice the direct tax may be remitted.

¶ 11. [CONTRACTS — HOW LET — EIGHT HOURS A DAY'S WORK.] § 11. All contracts for work to be done by such municipality, the expense of which will exceed five hundred dollars, shall be let to the lowest responsible bidder therefor, upon not less than sixty days' public notice of the terms and conditions upon which the contract is to be let having been given by publication in a newspaper of general circulation, published in said district, and the said board shall have the power and authority to reject any and all bids, and re-advertise; *provided*, no person shall be employed on said work unless he be a citizen of the United States, or has in good faith declared his intentions to become such citizen. In all cases where an alien, after filing his declaration of intention to become a citizen of

the United States, shall, for the space of three months after he could lawfully do so, fail to take out his final papers and complete his citizenship, such failure shall be *prima facie* evidence that his declaration of intentions was not made in good faith. And that eight hours shall constitute a day's work. The courts cannot control and determine a question vested by statute in a municipal body—163–285. The courts, in the absence of fraud, cannot, by mandamus or mandatory injunction, restrain a municipal board from entering into such a contract for public work as it may award to the bidder—163–285.

¶ 12. [TRUSTEES MAY LEVY AND COLLECT TAXES—MOVABLE BRIDGES.] § 12. The board of trustees may levy and collect taxes for corporate purposes upon property within the territorial limits of such sanitary district, the aggregate amount of which for each of the years 1895, 1896, 1897, 1898 and 1899 shall not exceed one and one-half per centum of the value of the taxable property within the corporate limits, as the same shall be assessed and equalized for the State and county taxes of the year in which the levy is made, and the aggregate amount of which in any one year after the year 1899 shall not exceed one-half of one per centum of such value. Said board shall cause the amount required to be raised by taxation in each year to be certified to the county clerk on or before the second Tuesday in August, as provided in section one hundred and twenty-two of the general revenue law. All taxes so levied and certified shall be collected and enforced in the same manner and by the same officers as State and county taxes, and shall be paid over by the officer collecting the same to the treasurer of the sanitary district, in the manner and at the time provided by the general revenue law; *provided*, that no part of the taxes hereby authorized shall be used by such drainage district for the construction of permanent, fixed, immovable bridges across any channel constructed under the provisions of this Act; and, *provided further*, that all bridges built across such channel shall not necessarily interfere with or obstruct the navigation of such channel, when the same becomes a navigable stream, as provided in Section 24 of this Act, but such bridges shall be so constructed that they can be raised, swung or moved out of the way of vessels, tugs, boats or other water craft navigating such channel; and, *provided further*, that nothing in this Act shall be so construed as

to compel said district to maintain or operate said bridges, as movable bridges, for a period of seven years from and after the time when the water has been turned into said channel pursuant to law, unless the needs of general navigation on the Desplaines and the Illinois Rivers, when connected with said channel, sooner require it.

As amended by Laws of 1895, page 168, June 18, July 1, and Laws of 1897, page 76, May 14, July 1, 1897.

Amendment increases taxes for 1895 to 1899, inclusive, one per cent.

Under the Constitution of 1848, Section 5, Article 9, held that only those corporations named, viz.: counties, towns, etc., could be empowered with the right to assess and collect taxes. (Harvard v. St. Clair, etc., 51-130. Otherwise under the Constitutions of 1870 and 1818, Wilson v. Board of Trustees, 133-443.)

¶ 13. [EXPENSES OF IMPROVEMENT—SPECIAL ASSESSMENTS —GENERAL TAX.] § 13. The board of trustees shall have power to defray the expense of any improvement made by it in the execution of the powers hereby granted to such incorporation, by special assessment or by general taxation, or partly by special assessment and partly by general taxation, as they shall by ordinance prescribe. It shall constitute no objection to any special assessment, that the improvement for which the same is levied is partly outside the limits of such incorporation, but no special assessment shall be made upon property situated outside of such sanitary district, and in no case shall any property be assessed more than it will be benefited by the improvement for which the assessment is levied. The proceedings for making, levying, collecting and enforcing of any special assessment, levied hereunder, shall be the same as nearly as may be as is prescribed by Article 9 of an Act entitled "An Act to Provide for the Incorporation of Cities and Villages," Approved April 10, 1872. Whenever in said Act the words "city council" are used, the same shall apply to the board of trustees constituted by this Act, and the words applying to the city or its officers in that article shall be held to apply to the corporation hereby created and to its officers.

¶ 14. [ASSESSMENT INSTALLMENTS — INTEREST.] § 14. When any assessment is made under this Act, the ordinance authorizing such assessment may provide that it be divided

into equal annual installments, not more than twenty in number, and fix the amount and time of payment of each installment, and that the installment shall bear interest at a rate not exceeding six per cent. per annum, payable annually, from the date fixed in said ordinance, and the several installments and interest thereon may be collected and enforced, as they shall become due, in the manner provided for the enforcement of assessments under said Article 9. No more of any assessment need be returned or certified to the county collector than will show the amount due and unpaid at the time of such return, and no sale of any parcel of land for any installment of an assessment shall discharge the premises from any subsequent installment of the same or any other assessment. Any one or all of the installments may be paid any time after the assessment is confirmed, with accrued interest, if any, to the date of payment.

¶ 15. [When Assessments Payable by Installments—Bonds May be Issued.] § 15. Where any assessment is made payable in installments, the board of trustees may issue bonds or certificates not exceeding in amount eighty per centum of the unpaid portion of such assessment at the date of the issue thereof, payable only out of such assessment, and bearing interest at a rate not exceeding the rate of interest upon the installments of such assessments. The board of trustees shall have the right to call in and pay off said bonds or certificates as fast as there is money received into the treasury from the assessment against which the same are issued, and all money received upon such assessment shall be applied to the payment of said certificates or bonds until they are fully satisfied.

¶ 16. [Private Property—How Taken for Improvement.] § 16. Whenever the board of trustees of any sanitary district shall pass an ordinance for the making of any improvement which such district is authorized to make, the making of which will require that private property should be taken or damaged, such district may cause compensation therefor to be ascertained, and condemn and acquire possession thereof in the same manner as nearly as may be as is provided in an Act entitled, "An Act to provide for the exercise of the right of eminent domain," Approved April 10, 1872; *provided, however*, that proceedings to ascertain the compensation to be paid for

taking or damaging private property shall in all cases be instituted in the county where the property sought to be taken or damaged is situated; *and, provided*, that all damages to property, whether determined by agreement or by final judgment of court, shall be paid out of the annual district tax, prior to the payment of any other debt or obligation. The present value of land condemned is the proper measure of damages for its condemnation, but possible increase on account of proposed improvement cannot be considered. 160–362.

Where a tenant erected upon the demised premises certain buildings, structures and fixtures, and afterwards took another lease for the same for five (5) years, and which was extended twice after its expiration, each time one year, without any reservation of the right to remove such buildings, etc., it was held, in condemnation proceedings, that the buildings, structures and fixtures in question belonged to the landlord, and that he and not the tenant was entitled to compensation for the same. (Cook vs. Sanitary District of Chicago. 67–286.)

¶ 17. [May Acquire Right of Way.] § 17. When it shall be necessary in making any improvements, which any district is authorized by this Act to make, to enter upon any public property, or property held for public use, such district shall have the power so to do and may acquire the necessary right of way over such property held for public use in the same manner as is above provided for acquiring private property, and may enter upon, use, widen, deepen and improve any navigable or other waters, waterways, canal or lake; *provided*, the public use thereof shall not be unnecessarily interrupted or interfered with, and that the same shall be restored to its former usefulness as soon as practicable; *provided, however*, that no such district shall occupy any portion of the Illinois and Michigan Canal outside of the limits of the county in which such district is situated for the site of any such improvement, except to cross the same, and then only in such a way as not to impair the usefulness of said canal, or to the injury of the right of the State therein, and only under the direction and supervision of the canal commissioners; *and, provided further*, that no district shall be required to make any compensation for the use of so much of said canal as lies within the limits of the county in which said district is situated, except for transportation purposes.

¶ 18. [SPECIAL ASSESSMENT—DAMAGE TO PROPERTY, AND COST OF ACQUIRING.] § 18. In making any special assessment for any improvement which requires the taking or damaging of property, the cost of acquiring the right to damage or take such property may be estimated and included in the assessment as a part of the cost of making such improvement.

¶ 19. [LIABILITY OF SANITARY DISTRICT FOR DAMAGES.] § 19. Every sanitary district shall be liable for all damages to real estate within or without such district which shall be overflowed or otherwise damaged by reason of the construction, enlargement, or use of any channel, ditch drain, outlet or other improvement under the provisions of this Act; and actions to recover such damages may be brought in the county where such real estate is situate, or in the county where such sanitary district is located, at the option of the party claiming to be injured. And in case judgment is rendered against such district for damages, the plaintiff shall also recover his reasonable attorney's fees, to be taxed as costs of suit; *provided, however*, it shall appear on the trial that the plaintiff notified the trustees of such district, in writing, at least sixty days before such suit was commenced, by leaving a copy of such notice with some one of the trustees of such district, stating that he claims damages to the amount of.....dollars, by reason of (here insert the cause of damage) and intends to sue for the same; *and provided, further*, that the amount recovered shall be larger than the amount offered by said trustees (if anything) as a compromise for damages sustained.

¶ 20. [CAPACITY OF CHANNEL OR OUTLET.] § 20. Any channel or outlet constructed under the provisions of this Act, which shall cause the discharge of sewage into or through any river or stream of water beyond or without the limits of the district constructing the same, shall be of sufficient size and capacity to produce a continuous flow of water of at least two hundred cubic feet per minute for each one thousand of the population of the district drained thereby, and the same shall be kept and maintained of such size and in such condition that the water thereof shall be neither offensive or injurious to the health of any of the people of this State, and before any sewage shall be discharged into such channel or outlet all garbage, dead animals, and parts thereof, and other solids, shall be taken

therefrom *and said district shall, at the time any sewage turned into or through any such channel or channels, turn into such channel or channels not less than 20,000 cubic feet of water per minute for every 100,000 inhabitants of said district, and shall thereafter maintain the flow of such quantity of water.

As amended by L. 1895, p. 168, June 10, July 1.
Amendment adds all after the asterisk (*).

¶ 21. [SANITARY DISTRICT—FAILURE TO COMPLY WITH ACT—REMEDY—PENALTY.] § 21. In case any sanitary district in this State, formed under the provisions of this Act, shall introduce sewage into any river or stream of water, or natural or artificial water course, beyond or without the limits of such district, without conforming to the provisions of this Act, or having introduced such sewage into such water course, shall fail to comply with any of the provisions of this Act, an action to enforce compliance shall be brought by the attorney general of this State in the courts of any county wherein such water course is situated, or he may authorize the State's attorney of any such county to commence and prosecute such action in any such county; *provided*, that nothing in this section contained shall be construed to prevent the prosecution of any action or proceeding by individuals or bodies corporate or politic against such district; *and*, *provided further*, that if any individual or the authorities of any municipal corporation shall file with the attorney general a verified statement, in writing, setting forth wherein said sanitary district has failed to comply with any of the provisions of this Act, it shall be the duty of the attorney general forthwith to file in the Supreme Court of this State a petition for mandamus, setting forth wherein said sanitary district has failed to comply with the provisions of this Act, and said court shall thereupon hear and determine such cause, and proceed to enforce compliance with the provisions of this Act, as in other cases of mandamus.

And, in order to comply with the provisions of this Act, such sanitary district is hereby authorized and empowered to levy and collect such tax, as an emergency tax, upon the taxable property of such sanitary district as may be necessary to carry into effect any order, judgment or decree of said court relating

to the requisite flowage of water, capacity of the channel or outlet and the construction, maintenance and operation of movable bridges, as required by this Act.

Amended 1895 and 1897. The above takes the place of old Section 21. This section (relating to Desplaines River) is not opposed to Article 4, Section 13, Constitution of 1870 (People v. Nelson, 133-565).

¶ 22. [ACT—HOW CONSTRUED.] § 22. Nothing in this Act contained shall be so construed as to constitute a contract or grant between the State of Illinois and any sanitary district formed under its provisions, or to prevent, debar or deprive the State of Illinois from, at any time in the future, altering, amending or repealing this Act, or imposing any conditions, restrictions or requirements other, different or additional to any herein contained upon any sanitary district which may be formed hereunder.

¶ 23. [CHANNEL—HOW TO BE CONSTRUCTED.] § 23. If any channel is constructed under the provisions hereof by means of which any of the waters of Lake Michigan shall be caused to pass into the Desplaines or Illinois Rivers, such channel shall be constructed of sufficient size and capacity to produce and maintain at all times a continuous flow of not less than 300,000 cubic feet of water per minute, and to be of a depth of not less than fourteen feet, and a current not exceeding three miles per hour, and if any portion of any such channel shall be cut through a territory with a rocky stratum where such rocky stratum is above a grade sufficient to produce a depth of water from Lake Michigan of not less than eighteen feet, such portion of said channel shall have double the flowing capacity above provided for, and a width of not less than one hundred and sixty feet at the bottom capable of producing a depth of not less than eighteen feet of water. If the population of the district draining into such channel shall at any time exceed 1,500,000, such channel shall be made and kept of such size and in such condition that it will produce and maintain at all times a continuous flow of not less than 20,000 cubic feet of water per minute for each 100,000 of the population of such district, at a current of not more than three miles per hour, and if at any time the general government shall improve the Desplaines or Illinois Rivers, so that the same shall be capable of receiving a flow of 600,000

cubic feet of water per minute, or more, from said channel, and shall provide for the payment of all damages which any extra flow above 300,000 cubic feet of water per minute from such channel may cause to private property so as to save harmless the said district from all liability therefrom, then such sanitary district shall, within one year thereafter, enlarge the entire channel leading into said Desplaines or Illinois Rivers from said district to a sufficient size and capacity to produce and maintain a continuous flow throughout the same of not less than 600,000 cubic feet of water per minute, with a current of not more than three miles per hour, and such channel shall be constructed upon such grade as to be capable of producing a depth of water not less than eighteen feet throughout said channel, and shall have a width of not less than one hundred and sixty feet at the bottom. In case a channel is constructed in the Desplaines River, as contemplated in this section, it shall be carried down the slope between Lockport and Joliet to the pool, commonly known as the upper basin, of sufficient width and depth to carry off the water the channel shall bring down from above. The district constructing a channel to carry water from Lake Michigan of any amount authorized by this Act, may correct, modify and remove obstructions in the Desplaines and Illinois Rivers wherever it shall be necessary so to do to prevent overflow or damage along said river, and shall remove the dams at Henry and Copperas Creek, in the Illinois River, before any water shall be turned into the said channel. And the canal commissioners, if they shall find at any time that an additional supply of water has been added to either of said rivers, by any drainage district or districts, to maintain a depth of not less than six feet from any dam owned by the State, to and into the first lock of the Illinois and Michigan Canal at La Salle, without the aid of any such dam, at low water, then it shall be the duty of said canal commissioners to cause such dam or dams to be removed. This Act shall not be construed to authorize the injury or destruction of existing water power rights.

This section (in relation to Desplaines River, etc.), is not in contravention of Article 4, Section 13, Constitution of 1870. People v. Nelson, 133-565.

¶ 24. [CHANNEL—WHEN COMPLETED, CONTROL OF.] § 24. When such channel shall be completed, and the water turned therein, to the amount of 300,000 cubic feet of water per minute, the same is hereby declared a navigable stream, and whenever the general government shall improve the Desplaines and Illinois Rivers for navigation, to connect with this channel, said general government shall have full control over the same for navigation purposes, but not to interfere with its control for sanitary or drainage purposes.

This section does not violate Article 4, Section 13, Constitution of 1870 (People v. Nelson, 133-565).

¶ 25. [MAY PERMIT TERRITORIES OUTSIDE TO DRAIN, ETC.] § 25. Any district formed hereunder shall have the right to permit territory lying outside its limits and within the same county to drain into and use any channel or drain made by it, upon such payments, terms and conditions as may be mutually agreed upon, and any district formed hereunder is hereby given full power and authority to contract for the right to use any drain or channel which may be made by any other sanitary district, upon such terms as may be mutually agreed upon, and to raise the money called for by any such contract in the same way and to the same extent as such district is authorized to raise money for any other corporate purposes; *provided*, that where the united flow of any sanitary districts thus co-operating shall pass into any channel constructed within the limits of the county wherein such districts are located, and which passes into the Desplaines or Illinois Rivers, such united flow shall in no case and at no time be less than 20,000 cubic feet of water per minute for each one hundred thousand of the aggregate of the population of the districts co-operating; *provided*, nothing in this Act shall in any wise be so construed as to diminish, impair or remove any right or rights of any city, village, township or corporation, body politic or individual, situated on the Desplaines or Illinois Rivers, or their tributaries, and within the valleys of the same, to use the channel for drainage or otherwise not inconsistent with the rights of the district constructing the same, as expressed in this Act.

¶ 26. [WHEN CITY OR VILLAGE OWNS WATERWORKS, ETC.] § 26. Whenever in any such sanitary district there shall be a city, incorporated town or village, which owns a system of

waterworks and supplies water from a lake or other source which will be saved and preserved from sewage pollution by the construction of the main channel, drain, ditch or outlet herein provided for, and the turning of the sewage of such city and district therein, and there shall be in such sanitary district any territory bordering on any such city, incorporated town or village within the limits of another city, incorporated town or village, which does not own any system of waterworks, at the time of the creation of such sanitary district, then upon application by the corporate authorities of such latter named city, incorporated town or village, the corporate authorities of such city, incorporated town or village having such system of waterworks shall furnish water at the boundary line between such municipalities by means of its waterworks to the corporate authorities asking for the same in such quantities as may be required to supply consumers within said territory, at no greater price or charge than it charges and collects of consumers, within its limits for water furnished through meters in like large quantities.

¶ 27. [When Channel Constructed—Commissioners to be Appointed to Inspect its Work.] § 27. If any channel shall be constructed under the provisions of Section 23 of this Act, it shall be the duty of the trustees of such district, when such channel shall be completed, and before any water or sewage shall be admitted therein, to duly notify, in writing, the Governor of this State of such fact; and the Governor shall thereupon appoint three discreet persons as commissioners, one of whom shall be a resident of the City of Joliet, or between said city and the City of La Salle, and one a resident of the City of La Salle, or between said city and the City of Peoria, and one a resident of the City of Peoria, or between said city and the mouth of the Illinois River, to inspect said work. The said commissioners shall, within ten days after such appointment, meet at the City of Chicago, and shall appoint a competent civil engineer, and they may employ such other assistance as they may require to expeditiously perform their duties. The said commission shall take as their datum line for the survey the datum established by the Illinois and Michigan Canal Trustees in 1847, and shall make such examination and

surveys of Chicago River and of the channel or channels authorized by this Act as shall enable them to ascertain whether said channel is of the character and capacity required by this Act. And in case they shall find the work in all respects in accordance with the provisions of Section 23 of this Act, they shall so certify to the Governor, who shall thereupon authorize the water and sewage to be let into said channel. But in case said commissioners shall find said channel is not constructed in accordance with the provisions of this Act, it shall be their duty to file in any court of competent jurisdiction, on the chancery side thereof, in their name as such commissioners, a bill against said corporation, which bill shall set forth wherein said work is deficient and fails to comply with the provisions of this Act; and said court shall thereupon issue an injunction without bond against said defendant, enjoining and restraining it from admitting water or sewage into said channel until the final order of the court. And in case said court, upon hearing, shall determine that said channel is not constructed in accordance with the provisions of this Act, said injunction shall be continued until the provisions of this Act shall have been fully complied with.

Such commissioners and engineer shall receive for their services ten dollars per day each, and their reasonable expenses and outlays for the time by them necessarily employed in the discharge of their duties, which shall be paid to them from the State treasury; and the said sanitary district shall reimburse the State for all expenses and disbursements on account of said commission.

If any channel is constructed under the provisions of this Act which shall discharge the sewage of a population of more than 300,000 into or through any river beyond or without the limits of the district constructing it, the same shall be constructed in accordance with the provisions of Section 23 of this Act, and if any such channel receives its supply of water from any river or channel connecting with Lake Michigan it shall be construed as receiving its supply of waters from Lake Michigan.

POLICE POWER—SANITARY DISTRICT OF CHICAGO.

AN ACT CONFERRING POLICE POWER UPON THE SANITARY DISTRICT OF CHICAGO.

¶ 28. SECTION 1. *Be it enacted by the People of the State of Illinois, represented in the General Assembly*, That the Sanitary District of Chicago shall have the right and power to appoint and support a police force, the members of which may have and exercise police powers over and within its right of way and for a distance of one and one-half miles on each side of its main drainage channel, such police powers as are conferred upon and exercised by the police of organized cities and villages; but such police force, when acting within the limits of such city or village, shall act in aid of the regular police force of such city or village, and shall then be subject to the direction of its chief of police, city or village marshals, or other head thereof.

Approved June 16, 1893.

In force July 1, 1893. L. 1893, p. 96.

UNITED STATES.

IMPROVEMENT OF THE ILLINOIS AND DESPLAINES RIVERS.

SECTION.
18. Repeal.
19. Works Ceded to the United States on Condition.
20. Conditions—Removal of Dam.
21. Basis of Act of Cession.

AN ACT in Reference to the Improvement of the Illinois and Desplaines Rivers, and to Repeal an Act entitled "An Act to Cede Certain Locks and Dams in the Illinois River to the United States," Approved May 31, 1887, in force May 31, 1887. Approved June 4, 1889. In force July 1, 1889.

18. REPEAL.] § 1. *Be it enacted by the People of the State of Illinois, represented in the General Assembly*, That an Act entitled "An Act to cede certain locks and dams in the Illinois River to the United States," Approved May 31, 1887; in force May 31, 1887, and ceding to the State works at Henry and Copperas Creek, and the pools created by said works, to the General Government, upon certain conditions as to the opening

of a waterway of a depth of seven feet from the Mississippi River to Lake Michigan, upon plans to be determined by United States engineers, is hereby repealed.

19. CONDITIONS ON WHICH WORKS ARE CEDED TO THE UNITED STATES.] § 2. That the State works at Henry and Copperas Creek, and the river now slack-watered by said works, are hereby ceded to the United States, on condition that the dams shall be removed whenever the depth now available for navigation can be secured and maintained by channel improvement without the aid of said dams; *provided*, that said depth shall be assured upon the removal of said dams, or that such removals shall not materially impair navigation.

20. REMOVAL OF DAM—CONDITIONS.] § 3. That in the event of the non-acceptance of these works upon the conditions mentioned in Section 2, within four (4) years after this Act becomes a law, the Canal Commissioners of the State of Illinois are authorized and instructed to remove the dams at Henry and Copperas Creek.

21. BASIS OF ACT OF CESSION.] § 4. That the State of Illinois bases this act of cession upon the condition that the plan of improving the Illinois River below La Salle by slack-water, maintained by dams and locks, be changed to a plan of improvement by means of an open channel in conjunction with a water supply from Lake Michigan.

[This Act is in place of Sections 18 and 19, on page 1321, Hurd's Revised Statutes, 1887.—ED.]

RESOLUTION CEDES TO UNITED STATES JURISDICTION OVER CERTAIN LAND FOR WIDENING THE CHICAGO RIVER.

Be it Resolved by the Senate of the State of Illinois, the House of Representatives concurring therein:

That the assent of the General Assembly of the State of Illinois be and the same is hereby given to the United States to acquire title to, by purchase or condemnation proceedings, in accordance with the laws of the United States and this State,

and to hold and possess all lands necessary for widening the Chicago River and its branches, as provided for by Act of Congress, entitled, "An Act making appropriations for the construction, repair and preservation of certain public works on rivers and harbors, and for other purposes," which became a law June 3, 1896, and the State of Illinois hereby ceded to the United States jurisdiction over any or all lands so acquired.

Adopted by the Senate April 22, 1897.
Concurred in by the House of Representatives April 23, 1897.

JOINT RESOLUTION.

WHEREAS, The present addition to the low water volume of the Illinois River through the summit level of the Illinois and Michigan Canal from Lake Michigan, more than doubles the volume of water used in the estimate of 1868 for the channel below Peru, and adds fifty per cent to the volume used in the estimate of 1880 for the channel below Copperas Creek, and said contribution from Lake Michigan will be increased in the immediate future, thus enabling the depth now projected for navigation below Peru to be obtained by channel improvement at moderate cost, and with decided advantage to material interests and to healthfulness along the valley.

WHEREAS, It is contemplated to increase the volume from Lake Michigan to 300,000 cubic feet per minute within a few years, and ultimately to add 600,000 cubic feet or more, thus enabling a large depth for navigation to be obtained by an improved channel, and that said channel will be self-sustaining and self-improving, and will discharge flood waters more readily, thus benefiting the bordering lands and increasing the healthfulness of the valley.

WHEREAS, Works now projected by the City of Chicago will form part of a waterway of large proportions from Lake Michigan via the Desplaines and Illinois Rivers to the Mississippi River, of which the dams and locks upon the alluvial section of the Illinois River can form no part, and which, if

allowed to remain, will increase, overflow and be detrimental to the welfare of the Illinois Valley and the interests of the State; therefore, be it

Resolved, by the Senate, the House of Representatives concurring therein:

1. That it is the policy of the State of Illinois to procure the construction of a waterway of the greatest practicable depth and usefulness for navigation from Lake Michigan via the Desplaines and Illinois Rivers to the Mississippi River, and to encourage the construction of feeders thereto of like proportions and usefulness.

2. That the United States is hereby requested to stop work upon the locks and dams at La Grange and at Kampsville, and to apply all funds available and future appropriations to the improvement of the channel from La Salle to the mouth with a view of such a depth as will be of present utility and in such manner as to develop progressively all the depth practicable by the aid of a large water supply from Lake Michigan at Chicago.

3. That the United States is requested to aid in the construction of a channel not less than 160 feet wide and 22 feet deep, with such a grade as to give a velocity of three miles per hour from Lake Michigan at Chicago to Lake Joliet, a pool of the Desplaines River immediately below Joliet, and to project a channel of similar capacity and not less than 14 feet deep, from from Lake Joliet to La Salle, all to be designed in such manner as to permit future development to a greater capacity.

SANITARY DISTRICTS—POLICY OF THE STATE—SANITARY CANAL OF CHICAGO.

WHEREAS, The General Assembly in 1889 passed "An Act to create sanitary districts," and provided thereunder for the disposal of the sewage of the City of Chicago through the Desplaines and Illinois Rivers, by means of a canal across the Chicago Divide of such capacity as to dilute the sewage beyond offense; and such sewage disposal was granted on the condition that said channel should be so constructed as to form part of a

navigable waterway between Lake Michigan and the Mississippi River and on the theory that to produce a waterway of magnitude, as demanded by modern conditions, required a large and constant volume of water flowing through the Illinois River; and, further, it was provided that the State dams at Henry and Copperas Creek should be removed before the said waters should be turned through the said canal, and the United States was requested by joint resolution to stop work on the locks and dams at La Grange and at Kampsville, and to enter upon the improvement of the channel from La Salle to the mouth of the said Illinois River, and to develop progressively all the depths practicable by the aid of a large water supply from Lake Michigan; and

WHEREAS, Under the legislation aforesaid, and Acts supplemental thereto, the works of the Sanitary District of Chicago are so far advanced that the water will be turned through the same in the year 1899, and the general government, regardless of the wishes of the people of this State and of those most immediately concerned, has completed the locks and dams at La Grange and at Kampsville; and it is the experience of those familiar with the Illinois River that the dams therein below La Salle have produced a deterioration of the channel and an increase of overflow, and that they should be removed for the sanitary and agricultural benefit of the Illinois Valley, and furthermore, that said dams will be unnecessary for navigation and a further menace to the valley on the turning therein of the volume of water proposed from Lake Michigan at Chicago and

WHEREAS, The construction of the Sanitary Canal of Chicago and the large volume of water required to flow through the same will bring lake and river navigation, which are now 320 miles apart, within sixty miles of each other, and the development of the intermediate section between Lockport and Utica will furnish a through route from the Great Lakes to the lower Mississippi by way of the lower Illinois River, and to the upper Mississippi by way of the Hennepin Canal; and further, that the proportion of three routes constructed by the Sanitary District of Chicago will exceed the cost of extending the largest useful navigation by way of the Illinois River to the

lower Mississippi, together with that of the Hennepin Canal to the upper Mississippi; and

WHEREAS, We believe the making of a deep waterway of the Illinois River to be an undertaking which is national in its character and should be accomplished by the general government, for the general welfare, the inland and maritime commerce of the nation, and for the nation's defense in time of war; therefore, be it

Resolved, by the Senate, the House of Representatives concurring therein:

1. That it is the policy of the State of Illinois to procure the construction of a waterway of the greatest practicable depth and usefulness for navigation from Lake Michigan by way of the Desplaines and Illinois Rivers to the lower Mississippi River, and by way of the Hennepin Canal to the upper Mississippi River, and to encourage the construction of useful feeders thereto.

2. That the locks and dams on the Illinois River at La Grange and at Kampsville are detrimental to the sanitary and agricultural welfare of the Illinois Valley, and form no part of a proper development in the interest of navigation and should be removed whenever the supply of water, as required by law, is turned into said river by means of the Sanitary Canal of Chicago, and said district has removed the dams at Henry and Copperas Creek; and the United States is hereby respectfully requested to remove the said dams and to enter upon the improvement of the alluvial portion of the Illinois River by means of a system of channel improvements, so as to fully utilize the flow of water from Lake Michigan.

3. That the rock-bound section of the Desplaines and Illinois Rivers form (from) the end of the Sanitary Canal of Chicago at Lockport to the head of the alluvial river at Utica, should be developed for a navigable depth of not less than fourteen feet, and that the United States is requested to enter upon this work in co-operation with all lawful agencies provided for in this State and in harmony with the policy herein set forth.

4. That we demand the immediate removal of all dams constructed by the government across the Illinois River, whether the channel of the river is deepened or not, and our senators and

navigable waterway between Lake Michigan and the Mississippi River and on the theory that to produce a waterway of magnitude, as demanded by modern conditions, required a large and constant volume of water flowing through the Illinois River; and, further, it was provided that the State dams at Henry and Copperas Creek should be removed before the said waters should be turned through the said canal, and the United States was requested by joint resolution to stop work on the locks and dams at La Grange and at Kampsville, and to enter upon the improvement of the channel from La Salle to the mouth of the said Illinois River, and to develop progressively all the depths practicable by the aid of a large water supply from Lake Michigan; and

WHEREAS, Under the legislation aforesaid, and Acts supplemental thereto, the works of the Sanitary District of Chicago are so far advanced that the water will be turned through the same in the year 1899, and the general government, regardless of the wishes of the people of this State and of those most immediately concerned, has completed the locks and dams at La Grange and at Kampsville; and it is the experience of those familiar with the Illinois River that the dams therein below La Salle have produced a deterioration of the channel and an increase of overflow, and that they should be removed for the sanitary and agricultural benefit of the Illinois Valley, and, furthermore, that said dams will be unnecessary for navigation and a further menace to the valley on the turning therein of the volume of water proposed from Lake Michigan at Chicago; and

WHEREAS, The construction of the Sanitary Canal of Chicago and the large volume of water required to flow through the same will bring lake and river navigation, which are now 320 miles apart, within sixty miles of each other, and the development of the intermediate section between Lockport and Utica will furnish a through route from the Great Lakes to the lower Mississippi by way of the lower Illinois River, and to the upper Mississippi by way of the Hennepin Canal; and further, that the proportion of three routes constructed by the Sanitary District of Chicago will exceed the cost of extending the largest useful navigation by way of the Illinois River to the

ACT OF CONGRESS RELATIVE TO CHICAGO RIVER.

(Passed September 19, 1897, Chap. 907, Page 801, Vol. 1, Supplement U. S. Statutes, 1874-1891.)

SECTION 7. That it shall not be lawful to build any wharf, pier, dolphin, boom, dam, weir, breakwater, bulkhead, jetty, or structure of any kind outside established harbor lines, or in any navigable waters of the United States where no harbor lines are or may be established, without the permission of the Secretary of War, in any port, roadstead, haven, harbor, navigable river, or other waters of the United States, in such manner as shall obstruct or impair navigation, commerce, or anchorage of said waters, and it shall not be lawful hereafter to commence the construction of any bridge, bridge-draw, bridge piers and abutments, causeway or other works over or in any port, road, roadstead, haven, harbor, navigable river, or navigable waters of the United States, under any Act of the Legislative Assembly of any State, until the location and plan of such bridge or other works have been submitted to and approved by the Secretary of War, or to excavate or fill, or in any manner to alter or modify the course, location, condition or capacity of the channel of said navigable water of the United States, unless approved and authorized by the Secretary of War.

Provided, That this section shall not apply to any bridge, bridge-draw, bridge piers and abutments, the construction of which has been heretofore duly authorized by law, or be construed as to authorize the construction of any bridge, drawbridge, bridge piers and abutments, or other works, under an Act of the Legislature of any State over or in any stream, port, roadstead, haven or harbor, or other navigable water not wholly within the limits of such State.

State authorities or authorized local corporations may regulate and make improvements on rivers, etc., within State if

same does not impair navigation thereof or defeat improvement by general government.

Mobile Co. v. Kimball, 102, U. S., 691.

Monongahela Nav. Co. v. U. S., 148, U. S., 312.

Harmon v. Chicago, 147, U. S., 396.

Power of States over rivers within its borders plenary except as limited by Act of Congress.

Hamilton v. Vicksburg, 119, U. S., 280.

Chicago River and its branches is held to be navigable waters of United States subject to commercial regulations of Congress.

Escanaba T. Co. v. Chicago, 107, U. S., 678.

Miller v. Mayer, N. Y., 109, U. S., 385.

APPENDIX B.

NOTES ON SANITARY AND SHIP CANAL OF CHICAGO FROM CHICAGO TO JOLIET.

(From report by ISHAM RANDOLPH, Chief Engineer, Chicago, June 21, 1899.)

Distance from mouth of River to Junction of Main Channel with West Fork of South Branch at Robey Street, about six miles.

Length of Main Channel proper, Robey Street to Controlling Works at Lockport, 28.05 miles.

The dimensions of the Channel are: Robey Street to Summit, 7.8 miles; 110 feet wide at bottom; 198 feet at water line, with minimum depth of water 22 feet. Summit to Willow Springs, 5.3 miles; 202 feet wide at bottom, 290 feet wide at water line with 22 feet depth of water; grade of earth channel one foot in 40,000 feet or 1⅝ inches per mile. At Willow Springs the channel narrows to the walled and rock cross section, 160 feet wide at bottom, 162 feet at top; grade in rock one foot in 20,000 or 3¼ inches per mile.

The velocity in earth is figured for 1¼ miles per hour and in rock 1.9 miles per hour.

COST OF MAIN CHANNEL AND AUXILIARY WORK, SANITARY DISTRICT OF CHICAGO, UNDER CONTRACT AND ESTIMATED TO DATE OF PROPOSED COMPLETION, JANUARY 1, 1900.

CONSTRUCTION.

Diversion of Desplaines River	$ 1,000,156 38	
Main Channel, Robey Street to Lockport	18,303,136 39	
Controlling Works	253,637 39	
Chicago River Improvement, including Bridges	967,046 38	
Desplaines River Improvement, Controlling Works to Joliet	748,244 54	
Railroad and Highway Bridges, exclusive of Chicago River	1,825,363 15	
Miscellaneous	71,881 01	
Contingency Fund	50,000 00	
Estimated Cost of Construction		$23,219,465 24

MISCELLANEOUS.

Capitalization of Railroad Bridges		$ 450,000 00
Right of Way and Lands		3,167,908 22
Estimated Cost of Administration	$2,170,811 68	
Maintenance Account	94,566 44	
General Account	457,033 00	
		2,722,411 12
Total Estimated Cost, exclusive of Interest Account		$29,559,784 58
Estimated Interest Charges to January 1, 1900.		3,504,677 00
Grand Total.		$33,064,461 58

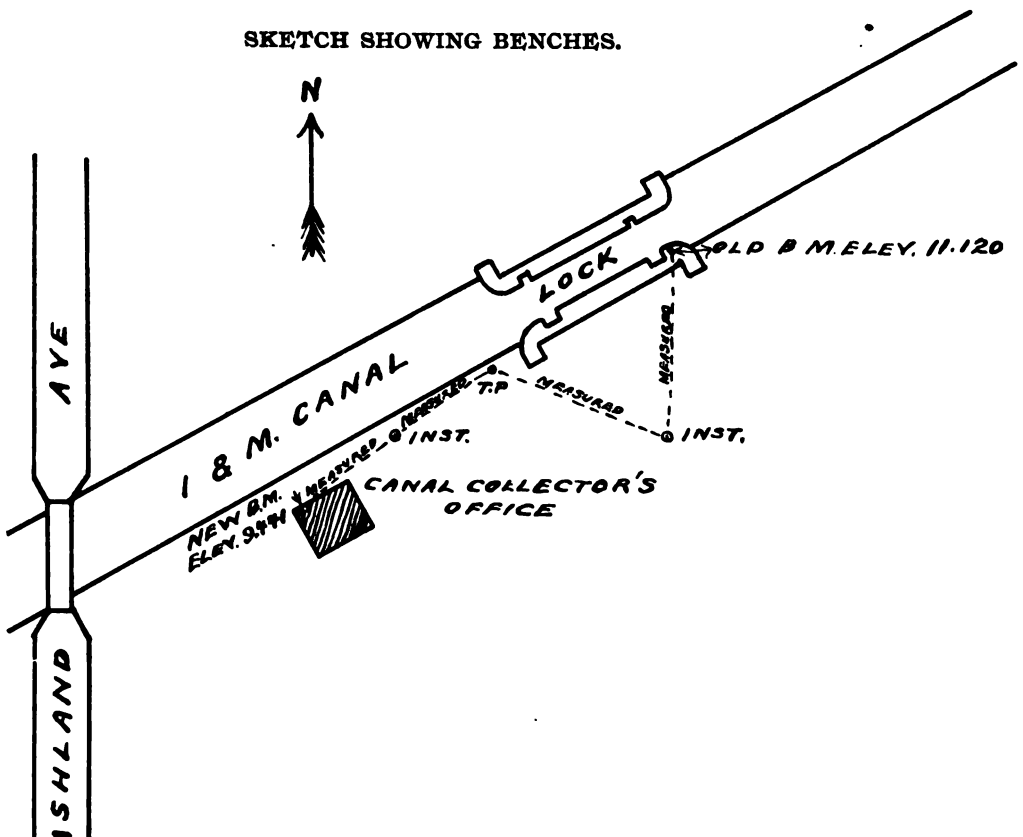
EXPENDITURES TO JUNE 1, 1899.

Right of Way	$ 3,167,908 22	
Construction	20,826,560 33	
Administration, including General Account	2,452,325 82	
Interest	2,570,369 72	
Capitalization of Bridges	92,162 10	
Maintenance	80,966 46	
		$29,190,292 65
Balance required to January 1, 1900		$ 3,874,168 93

QUANTITIES INVOLVED IN WORK—CUBIC YARDS.

	Main Channel.	River Diversion.	Totals.
Glacial Draft	28,303,202	1,801,339	30,104,541
Solid Rock	12,381,806	258,659	13,140,465
Retaining Wall			380,050
Bridge Masonry			79,804
Totals	41,185,008	2,059,998	
		41,185,008	
Grand Total, Glacial Drift and Solid Rock		43,245,006	

SKETCH SHOWING BENCHES.



APPENDIX C.

31 WINTHROP PLACE, CHICAGO, April 16, 1893.

MR. BENEZETTE WILLIAMS,
Chief Engineer, Sanitary District of Chicago.

DEAR SIR:—In reply to your letter of the 3rd inst., I will make the following statement:

In the construction of the Bridgeport Pumping Works it became necessary to remove the upper courses of masonry from the old lock in the Illinois & Michigan Canal at Ashland avenue. There were bench marks on the upper surface of one of the coping stones at the north end of the east wall of the lock. I am not positive as to whether they were two or three in number. One was neatly engraved, with the elevation 11.12 beside it. The lock-keeper stated this to be the one which he had seen put in by General Wilson.

In order to save these benches, I ran levels to a bench mark which I had prepared upon the west end of the door sill of the Canal Collector's office. This was done between June 23rd and July 10th, 1882.

I found that the benches all had the same elevation, as nearly as I could determine. For one of them the elevation 11.120 was given as reliable by Richard Potts, Assistant City Engineer, so I used this elevation.

In leveling the rod was waved and each reading repeated several times. The readings for each sight were all equal. The distances between the instrument and the sights were laid off equal by measurement. The accompanying sketch shows the position of the benches and the line over which the levels were run.

Mr. Potts had nothing to do with the transfer, and to my knowledge did not make the transfer between the old bench and that on the door step at any time.

Respectfully yours,

(Signed) FRANCIS MURPHY.

COPY OF TRANSFER NOTES.

B. S.	Inst.	F. S.	Elev.	
			11.120	North bench on coping of Canal Lock.
1.869	12.989	6.447	6.542	Transferred to west end of door sill, Canal Collector's office.
4.403	10.945	1.504	9.441	B. M. on west end Canal Collector's office on door sill.

I hereby certify that the statement within, made by me relative to the bench marks and notes of same, is correct and true to the best of my knowledge and belief.

(Signed) FRANCIS MURPHY, C. E.

Subscribed and sworn to before me this 18th day of April, 1893.

SAMUEL M. DICKSON,
Notary Public.

(Notarial Seal.)

APPENDIX D.

BOUNDARIES OF THE SANITARY DISTRICT.

"Which said boundaries and limits are otherwise described as follows:

"All of the territory embraced within the limits of the City of Chicago except the portion thereof lying south of the township line between townships thirty-seven (37) and thirty-eight (38) north, range fourteen (14) and fifteen (15) east of the third principal meridian, and which accepted portion of said City is that portion thereof south of Eighty-seventh (87th) street in said City, the foregoing territory including all the territory embraced prior to the recent annexation in the City of Lake View, in the Village of Jefferson, in the Town of Lake, in the portion of the Town of Cicero then annexed to Chicago, and in Hyde Park north of the said township line and said Eighty-seventh (87th) street; also all of the territory embraced in the incorporated Town of Cicero and also all of the territory embraced in the incorporated Village of Lyons, and also all of the territory of the Township of Lyons lying in range thirteen (13) east of the third principal meridian and in sections one (1), two (2), eleven (11), twelve (12), thirteen (13), fourteen (14), twenty-three (23) and twenty-four (24) of said Township of Lyons lying in range twelve (12) east of the third principal meridian; and that portion of Lake Michigan within the State of Illinois bounded by a line extended three miles due east from the shore of Lake Michigan at the point thereof where the northern boundary line of the said City of Chicago touches said lake shore; thence southerly and parallel with and three miles from the shore line

of the City of Chicago on Lake Michigan to the northern line of the State of Indiana; thence west on the said State line to the west line of said State of Indiana; thence south on said line to a point opposite and due east of the middle line of Eighty-seventh (87th) street in the City of Chicago, and thence due west to the middle line of said Eighty-seventh (87th) street, the foregoing being an area of contiguous territory situated in the County of Cook and State of Illinois."

In witness whereof we, the undersigned Commissioners, have hereunto set our hands and seals this 14th day of October, A. D. 1889.

(Signed) RICHARD PRENDERGAST. (Seal.)
SAMUEL P. MCCONNELL. (Seal.)
RICHARD S. TUTHILL. (Seal.)

EXTRACT FROM "DRAINAGE CHANNEL AND WATERWAY."

BY G. P. BROWN, PAGE 394.

"Compared with the boundaries of the City of Chicago those of the Sanitary District were as follows: On the north they were identical—along North Seventy-first street. Beginning at the northwest corner of the City limits the boundary line of the Sanitary District followed that of the City southward along an irregular line to the intersection of Irving Park boulevard and West Seventy-second street. At this point the boundaries separated, that of the district continuing south along the line of West Seventy-second street to Thirty-ninth street, taking in the Town of Cicero. The course was then westward two miles along Thirty-ninth street, south four miles and east again to West Seventy-second street, including Summit and the bend in the Desplaines River where the usual spring overflows occurred. A turn again to the southward along West Seventy-second street,

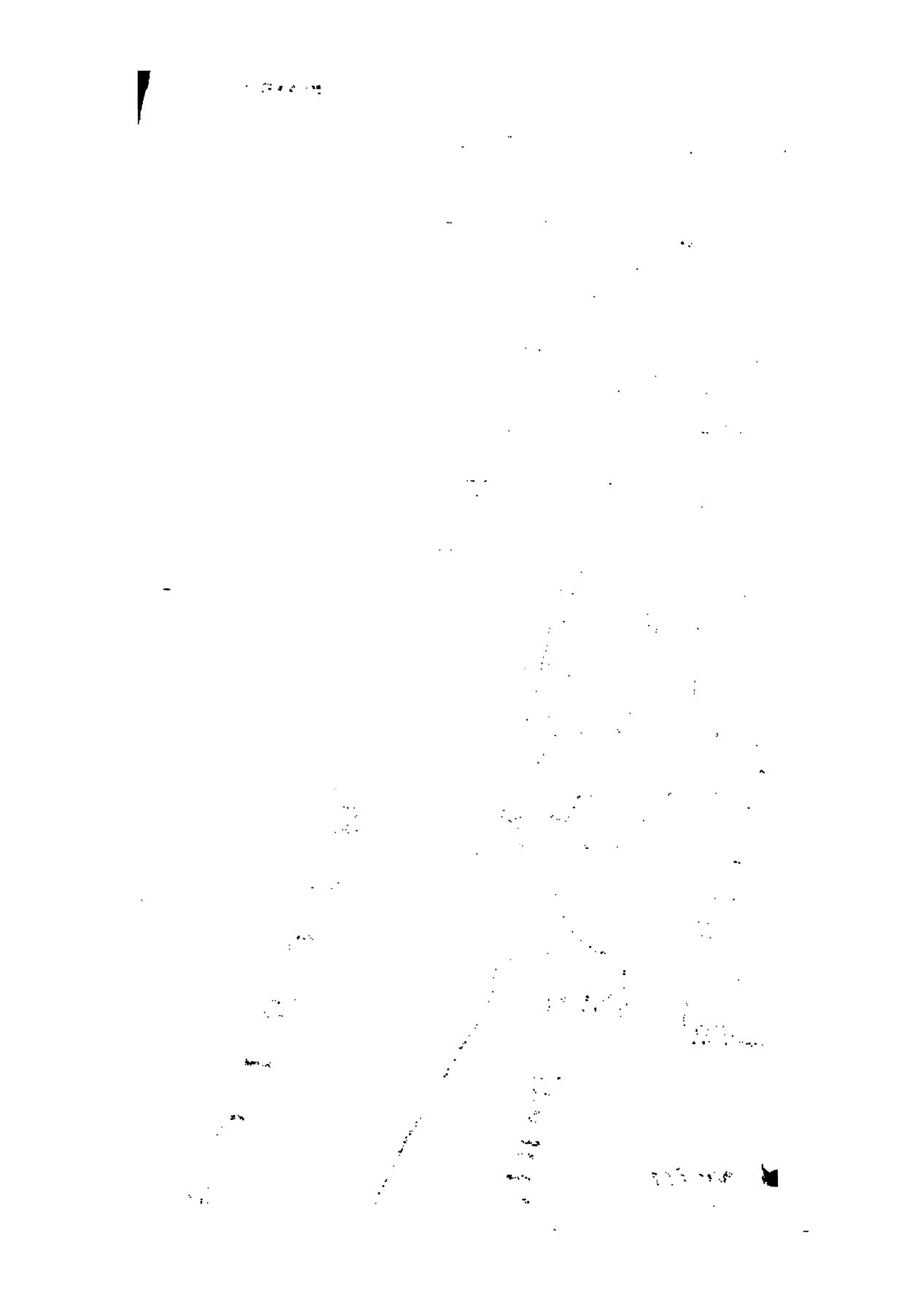
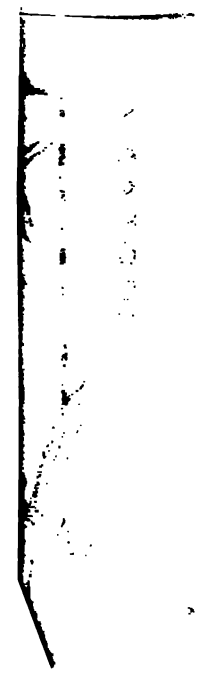


PLATE V.



APPENDIX E.

POPULATION OF THE CITY OF CHICAGO, 1899.

NORTH DIVISION.

GEOGRAPHICAL DISTRICT No. I.

WARD.	U. S. 1870	School 1872	School 1874	School 1876	School 1878	School 1880	U. S. 1880	School 1882	School 1884	School 1886	School 1888	School 1890	U. S. 1890	School 1892	School 1894	School 1896	School 1898
*18	17,084	19,977	21,392	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
19	8,716	2,944	4,677	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	13,628	5,023	8,995	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
†17	.....	.....	.....	19,109	21,166	24,668	24,666	27,990	31,252	30,754	.....	.....	.....	.....	.....	.....	.....
18	.....	.....	.....	16,643	17,926	23,957	22,517	25,848	27,226	31,317	.....	.....	.....	.....	.....	.....	.....
‡23	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	38,579	41,519	35,918	45,870	49,739	39,983	44,245
24	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	30,041	35,120	30,942	40,474	40,441	35,438	40,889
Totals..	39,428	27,944	35,064	35,752	39,092	48,625	47,183	53,838	58,478	62,071	68,620	76,639	66,860	86,344	90,180	75,421	85,134

*Act March 10, 1869. †Ordinance Feb. 28, 1876. ‡Ordinance Oct. 31, 1887.

GEOGRAPHICAL DISTRICT No. II.

WARD.	U. S. 1870	School 1872	School 1874	School 1876	School 1878	School 1880	U. S. 1880	School 1882	School 1884	School 1886	School 1888	School 1890	U. S. 1890	School 1892	School 1894	School 1896	School 1898
*16	14,045	19,099	22,031	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
17	18,078	17,513	20,777	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
†15	.....	.....	.....	24,076	27,406	27,498	28,749	33,004	39,968	45,195	.....	.....	.....	.....	.....	.....	.....
16	.....	.....	.....	20,520	21,511	23,390	23,774	25,439	30,050	31,267	.....	.....	.....	.....	.....	.....	.....
‡20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	22,597	27,126	21,705	30,296	36,546	32,287	36,331
21	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	30,620	35,335	30,225	38,663	37,864	34,029	37,685
22	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	32,283	36,505	31,843	39,706	40,650	36,474	43,299
Totals..	32,123	36,612	42,808	44,596	48,917	50,888	52,523	58,443	70,018	76,462	85,500	98,966	83,773	108,665	115,060	102,790	117,315

* Ordinance March 10, 1869. †Ordinance Feb. 28, 1876. ‡Ordinance Oct. 31, 1887.

CHICAGO.

TABLE OF ANNEXATIONS AND AREAS, 1899.

DATE.		ANNEXATIONS.	Area of Annexation.	Total Area of City.
			Square	Miles.
1837	March 4th ...	The City of Chicago. Town of Chicago, with extension to Twenty-second St. on the South, Wood St. on the West and North Ave. on the North		10.635
1847	Feb. 16th.....	First Annexation. Principally to Cicero line on the West	3.375	14.010
1853	Feb. 12th.....	Second Annexation. To Chicago River and Thirty-first St. on the South and to Fullerton Ave. on the North	3.988	17.998
1863	Feb. 13th.....	Third Annexation. Principally to Thirty-ninth St. on the South	6.284	24.282
1869	Feb. 27th.....	Fourth Annexation. Easterly portion of Cicero and a small part of Jefferson	11.380	35.662
1887	May 16th.....	Fifth Annexation. Part of Jefferson	1.000	36.662
1889	April 29th....	Sixth Annexation. Portion of Cicero and Village of Maplewood	7.150	43.812
1889	July 15th.....	Seventh Annexation. Village of Hyde Park 49.132 square miles; Town of Lake 36.000 " "; Town of Jefferson 29.530 " "; City of Lake View 10.408 " "; Part of Town of Cicero 1.000 " "	126.070	169.882
1890	April 1st.....	Eighth Annexation. Village of Gano	1.773	171.655
1890	May 12.....	Ninth Annexation. South Englewood	2.899	174.554
1890	Nov. 4th.....	Tenth Annexation. Village of Washington Heights 2.810 square miles; Village of W. Roseland 1.793 " "	4.603	179.157
1891	April 7th.....	Eleventh Annexation. Village of Fernwood	0.981	180.138
1893	April 4th.....	Twelfth Annexation. Village of West Ridge 2.125 square miles. Village of Rogers Park 1.750 " "	3.875	184.013
1893	Nov. 7th	Thirteenth Annexation. Village of Norwood Park	2.125	186.138
1895	Feb. 25th.....	Fourteenth Annexation. Small part of Calumet	1.000	187.138
1899	April 4th.....	Fifteenth Annexation. Part of Cicero (Austin)	3.500	190.638

Total Area City of Chicago, 190.638 square miles.

APPENDIX E.

POPULATION OF THE CITY OF CHICAGO, 1899.

NORTH DIVISION.

GEOGRAPHICAL DISTRICT No. I.

WARD.	U. S. 1870	School 1872	School 1874	School 1876	School 1878	School 1880	U. S. 1880	School 1882	School 1884	School 1886	School 1888	School 1890	U. S. 1890	School 1892	School 1894	School 1896	School 1898
*18	17,084	19,977	21,392	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
19	8,716	2,944	4,677	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	13,628	5,023	8,995	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
†17	.....	.....	.....	19,109	21,166	24,668	24,666	27,990	31,252	30,754	.....	.....	.....	.....	.....	.....	.....
18	.....	.....	.....	16,643	17,926	23,957	22,517	25,848	27,226	31,317	.....	.....	.....	.....	.....	.....	.....
‡23	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	38,579	41,519	35,918	45,870	49,739	39,983	44,245
24	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	30,041	35,120	30,942	40,474	40,441	35,438	40,889
Totals..	39,428	27,944	35,064	35,752	39,092	48,625	47,183	53,838	58,478	62,071	68,620	76,639	66,860	86,344	90,180	75,421	85,134

*Act March 10, 1869. †Ordinance Feb. 28, 1876. ‡Ordinance Oct. 31, 1887.

GEOGRAPHICAL DISTRICT No. II.

WARD.	U. S. 1870	School 1872	School 1874	School 1876	School 1878	School 1880	U. S. 1880	School 1882	School 1884	School 1886	School 1888	School 1890	U. S. 1890	School 1892	School 1894	School 1896	School 1898
*16	14,045	19,099	22,031	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
17	18,078	17,513	20,777	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
†15	.....	.....	.....	24,076	27,406	27,498	28,749	33,004	39,968	45,195	.....	.....	.....	.....	.....	.....	.....
16	.....	.....	.....	20,520	21,511	23,390	23,774	25,439	30,050	31,267	.....	.....	.....	.....	.....	.....	.....
‡20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	24,597	27,126	21,705	30,296	36,546	32,287	36,331
21	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	30,620	35,335	30,225	38,663	37,864	34,029	37,685
22	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	32,283	36,505	31,843	39,706	40,650	36,474	43,299
Totals..	32,123	36,612	42,808	44,596	48,917	50,888	52,523	58,443	70,018	76,462	85,500	98,966	83,773	108,665	115,060	102,790	117,315

* Ordinance March 10, 1869. †Ordinance Feb. 28, 1876. ‡Ordinance Oct. 31, 1887.

POPULATION OF THE CITY OF CHICAGO—NORTH DIVISION—Continued.

GEOGRAPHICAL DISTRICT No. III.

WARD.	U. S. 1870						U. S. 1880		School 1884	School 1885		School 1890	U. S. 1890	School 1892	School 1894	School 1896	School 1898
*Lake Vi'w	1,841	.....	.....	.....	.....	.....	6,565	.....	21,489	28,553	.....	.....	.....	.....	.....	.....	.....
25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	23,788	24,202	30,333	34,063	41,214	50,046
26	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	28,003	28,839	36,802	46,768	57,253	69,652
Totals	1,841	.....	.....	.....	.....	.....	6,565	.....	21,489	28,553	.....	51,791	53,041	67,135	80,831	98,467	119,698

*Town of Lake View annexed July 15, 1889, and Wards formed July 22, 1889.

GEOGRAPHICAL DISTRICT No. IV.

WARD.															School 1894	School 1896	School 1898
*Part of 25.	Roger	s Park	(Additi	on of 18	93)....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,906	3,564	3,871
Part of 26.	West	Ridge	(Additi	on of 18	93).....	.....	.....	.....	.....	.....	.....	.....	.....	.....	567	628	799
Totals	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,473	4,192	4,670

*Ordinance July 5, 1893.

SUMMARY.

DISTRICT.	U. S. 1870						U. S. 1880		School 1884			School 1890	U. S. 1890	School 1892	School 1894	School 1896	School 1898
No. I	39,428	.....	.....	.....	.....	.....	47,183	.....	58,478	.....	.....	76,639	66,860	86,344	90,180	75,421	85,134
No. II	32,123	.....	.....	.....	.....	.....	52,523	.....	70,018	.....	.....	98,966	83,773	108,665	115,060	102,790	117,315
No. III	1,841	.....	.....	.....	.....	.....	6,565	.....	21,489	.....	.....	51,791	53,041	67,135	80,831	98,467	119,698
No. IV	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,473	4,192	4,670
Totals	73,392	.....	.....	.....	.....	.....	106,271	.....	149,985	.....	.....	227,396	203,674	262,144	288,544	280,870	326,817

POPULATION OF THE CITY OF CHICAGO, 1899.

South Division.

GEOGRAPHICAL DISTRICT No. I.

Ward.	U. S. 1870	School 1872	School 1874	School 1876	School 1878	School 1880	U. S. 1880	School 1882	School 1884	School 1886	School 1888	School 1890	U. S. 1890	School 1892	School 1894	School 1896	School 1898
*1	6,522	398	5,725	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2	14,320	2,174	4,830	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3	17,681	19,157	14,861	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4	12,174	16,832	15,361	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
†1	.....	.....	.....	14,180	14,972	14,631	14,770	11,031	12,296	16,241	.....	.....	.....	.....	.....	.....	.....
2	.....	.....	.....	16,354	16,783	17,905	20,126	18,479	17,348	20,208	.....	.....	.....	.....	.....	.....	.....
3	.....	.....	.....	15,123	15,067	16,683	16,850	18,490	19,005	20,212	.....	.....	.....	.....	.....	.....	.....
‡1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	32,333	44,897	24,074	48,757	35,546	24,359	28,305
2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	26,964	30,562	25,581	34,951	33,923	29,827	31,179
Totals	50,697	38,561	40,777	45,657	46,822	49,219	51,746	48,000	48,649	56,661	59,297	75,459	49,655	83,708	69,469	54,186	59,484

*Act March 10, 1869. †Ordinance Feb. 28, 1876. ‡Ordinance Oct. 31, 1887.

GEOGRAPHICAL DISTRICT No. II.

Ward.	U. S. 1870	School 1872	School 1874	School 1876	School 1878	School 1880	U. S. 1880	School 1882	School 1884	School 1886	School 1888	School 1890	U. S. 1890	School 1892	School 1894	School 1896	School 1898
*5	11,566	18,564	20,078	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	19,445	31,371	35,916	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
†4	.....	.....	.....	21,568	24,055	27,102	28,029	30,573	35,738	39,574	.....	.....	.....	.....	.....	.....	.....
5	.....	.....	.....	37,543	40,239	45,711	47,479	57,069	65,177	76,144	.....	.....	.....	.....	.....	.....	.....
‡3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	28,052	30,511	28,040	34,938	39,999	36,626	39,420
4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	26,236	31,345	27,694	34,762	37,502	41,122	46,924
5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	40,067	40,642	41,009	45,267	51,813	52,289	60,236
6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	40,512	45,299	43,264	52,503	61,038	62,765	72,789
Totals	31,011	49,935	55,994	59,111	64,294	72,813	75,508	87,642	100,915	115,718	134,867	147,797	140,007	167,470	190,352	192,802	219,369

*Act March 10, 1869. †Ordinance Feb. 28th, 1876. ‡Ordinance Oct. 31, 1887.

POPULATION OF THE CITY OF CHICAGO, 1899—SOUTH DIVISION—Continued.

GEOGRAPHICAL DISTRICT No. III.

WARD.	U. S. 1870						U. S. 1880			School 1886	School 1888	School 1890	U. S. 1890	School 1892	School 1894	School 1896	School 1898
*Town of Lake	3,360	.....	.....	.....	.....	.....	18,380	.....	.....	45,331	60,543	.....	.....	.....	.....	.....	.....
29.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	31,139	31,632	38,207	41,041	40,334	46,307
30.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	49,818	49,134	69,249	84,662	93,074	110,062
Part of 31.	(Large	r part).	.....	.....	.....	.....	.....	.....	.....	.....	.....	20,237	17,757	29,735	34,229	39,681	49,749
Totals..	3,360	.....	.....	.....	.....	.....	18,380	.....	.....	45,331	60,543	101,194	98,523	137,191	159,932	173,089	206,118

*Ordinance July 22, 1889.

GEOGRAPHICAL DISTRICT No. IV.

WARD.												School 1890	U. S. 1890	School 1892	School 1894	School 1896	School 1898
*Part of 31.	(Small	Additi	ons by	annexa	tion)...	.....	.....	.....	.....	.....	.....	4,301	4,301	4,808	5,644	4,710	6,674

*Ordinance May 12, 1890. Resolution Feb. 2, 1891. Ordinance June 22, 1891.

GEOGRAPHICAL DISTRICT No. V.

WARD.	U. S. 1870						U. S. 1880			School 1886	School 1888	School 1890	U. S. 1890	School 1892	School 1894	School 1896	School 1898
*Hyde Park..	3,644	.....	.....	.....	.....	.....	15,716	.....	.....	46,174	71,434	.....	.....	.....	.....	.....	.....
32.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	29,412	26,775	38,385	45,801	54,172	64,246
33.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	29,230	26,039	38,194	34,420	41,611	46,692
Part of 34.	(Large	r part).	.....	.....	.....	.....	.....	.....	.....	.....	.....	27,925	28,506	39,892	48,723	54,430	66,327
Totals..	3,644	.....	.....	.....	.....	.....	15,716	.....	.....	46,174	71,434	86,567	81,320	116,471	128,944	150,213	177,265

*Ordinance July 22, 1889.

POPULATION OF THE CITY OF CHICAGO, 1899—SOUTH DIVISION—Continued.

GEOGRAPHICAL DISTRICT No. VI.

WARD.												School 1890	U. S. 1890	School 1892	School 1894	School 1896	School 1898
*Part of 34.	(Small	Additi	ons by	annexa	tion)...	.....	.....	.....	.....	.....	.....	3,093	3,093	6,088	8,639	10,298	11,617

*Ordinance April 21, 1890. Resolution Feb. 2, 1891. Ordinance Feb. 25, 1895.

SUMMARY.

DISTRICT.	U. S. 1870						U. S. 1880			School 1886	School 1888	School 1890	U. S. 1890	School 1892	School 1894	School 1896	School 1898
No. I.....	50,697	.....	.....	.....	.....	.....	51,746	.....	.....	56,661	59,297	75,459	49,655	83,708	69,469	54,186	59,484
No. II.....	31,011	.....	.....	.....	.....	.....	75,508	.....	.....	115,718	134,867	147,797	140,007	167,470	190,352	192,802	219,369
No. III....	3,360	.....	.....	.....	.....	.....	18,380	.....	.....	45,331	60,543	101,194	98,523	137,191	159,932	173,089	206,118
No. IV	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,301	4,301	4,808	5,644	4,710	6,674
No. V	3,644	.....	.....	.....	.....	.....	15,716	.....	.....	46,174	71,434	86,567	81,320	116,471	128,944	150,213	177,265
No. VI	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,093	3,093	6,088	8,639	10,298	11,617
Totals..	88,712	.....	.....	.....	.....	.....	161,350	.....	.....	263,884	326,141	*418,411	376,899	515,736	562,980	585,298	680,527

*5,708 added to published total of 412,703 for annexations.

POPULATION OF THE CITY OF CHICAGO, 1899.

WEST DIVISION.

GEOGRAPHICAL DISTRICT No. I.

WARD.	U. S. 1870	School 1872	School 1874	School 1876	School 1878	School 1880	U. S. 1880	School 1882	School 1884	School 1886	School 1888	School 1890	U. S. 1890	School 1892	School 1894	School 1896	School 1898
* 9	27,817	30,032	31,654	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	13,771	16,624	17,385	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
11	15,065	18,340	14,022	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12	13,976	20,876	16,792	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
† 8	.....	.....	.....	31,216	32,893	36,045	37,136	38,849	41,292	44,880	.....	.....	.....	.....	.....	.....	.....
9	.....	.....	.....	14,264	14,912	18,782	17,484	20,535	21,225	23,653	.....	.....	.....	.....	.....	.....	.....
10	.....	.....	.....	12,696	13,281	13,584	15,716	17,803	18,329	16,586	.....	.....	.....	.....	.....	.....	.....
11	.....	.....	.....	17,717	18,787	21,234	22,351	25,045	26,542	28,604	.....	.....	.....	.....	.....	.....	.....
‡Part of 9.	(Smaller part)	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,378	3,432	3,434	3,628	4,477	4,815	5,550
Part of 11.	(Greater part)	.....	.....	.....	.....	.....	.....	.....	.....	.....	25,810	29,089	27,407	33,500	34,647	32,626	34,290
Part of 17.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13,993	16,075	12,565	18,160	15,207	12,494	12,833
18	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	31,667	35,126	26,456	40,109	36,758	27,454	33,510
19	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	41,671	48,590	44,380	54,172	53,729	48,191	50,189
Totals	70,629	85,872	79,853	75,893	79,873	89,645	92,687	102,232	107,388	113,723	116,519	132,312	114,242	149,569	144,818	125,580	136,372

* Act March 10, 1869. † Ordinance Feb. 28, 1876. ‡ Ordinance Oct. 31, 1887.

GEOGRAPHICAL DISTRICT No. II.

WARD.	U. S. 1870	School 1872	School 1874	School 1876	School 1878	School 1880	U. S. 1880	School 1882	School 1884	School 1886	School 1888	School 1890	U. S. 1890	School 1892	School 1894	School 1896	School 1898
* 7	13,854	27,644	31,722	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
8	22,911	30,253	29,142	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
13	8,928	14,636	17,892	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	9,035	15,892	16,720	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
15	20,361	40,047	45,545	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
† 6	.....	.....	.....	31,258	33,942	41,163	40,881	48,612	54,876	66,578	.....	.....	.....	.....	.....	.....	.....
7	.....	.....	.....	31,393	33,126	35,219	37,450	41,525	46,107	47,270	.....	.....	.....	.....	.....	.....	.....
12	.....	.....	.....	19,839	23,364	27,160	27,892	31,675	36,102	43,580	.....	.....	.....	.....	.....	.....	.....
13	.....	.....	.....	16,350	17,929	20,364	20,851	23,884	26,078	28,276	.....	.....	.....	.....	.....	.....	.....
14	.....	.....	.....	47,812	49,372	56,420	56,464	64,842	81,380	93,478	.....	.....	.....	.....	.....	.....	.....

* Act March 10, 1869. † Ordinance Feb. 28, 1876.

POPULATION OF THE CITY OF CHICAGO, 1899—WEST DIVISION—Continued.

GEOGRAPHICAL DISTRICT No. II—Continued.

WARD.	U. S. 1870	School 1872	School 1874	School 1876	School 1878	School 1880	U. S. 1880	School 1882	School 1884	School 1886	School 1888	School 1890	U. S. 1890	School 1892	School 1894	School 1896	School 1898
*7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	36,398	45,669	34,957	49,264	44,244	42,049	46,582
8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	33,197	36,539	35,583	39,905	42,038	41,729	44,082
Part of 9.	(Greater part)	.....	.....	.....	.....	.....	.....	.....	.....	.....	33,214	38,009	38,040	41,404	45,164	51,554	54,164
10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	33,435	42,934	44,551	56,477	72,141	79,352	96,211
Part of 11.	(Smaller part)	.....	.....	.....	.....	.....	.....	.....	.....	.....	6,488	8,093	7,640	9,085	9,011	8,148	9,032
12	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	40,536	52,681	48,795	60,788	65,320	72,383	83,577
13	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	32,023	37,482	36,431	42,572	48,373	50,807	61,051
14	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	31,350	40,724	40,592	49,310	57,942	64,776	80,462
Part of 15.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	16,942	21,488	20,363	27,650	34,032	36,830	40,674
16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50,750	58,699	55,467	64,340	66,760	65,979	74,235
Part of 17.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10,596	12,258	9,287	13,286	14,503	12,393	12,538
Totals..	75,089	128,472	141,021	146,651	157,733	180,326	183,538	210,538	244,543	279,182	324,929	394,576	371,706	454,081	499,528	526,000	602,608

*Ordinance Oct. 31, 1887.

GEOGRAPHICAL DISTRICT No. III.

WARD.	U. S. 1870						U. S. 1880		School 1884	School 1886	School 1888	School 1890	U. S. 1890	School 1892	School 1894	School 1896	School 1898
†Jefferson.	1,813	.....	.....	.....	.....	.....	5,076	.....	13,374	16,960	11,080	.....	.....	.....	.....	.....	.....
‡Part of 15.	(Annexed May			and April 29, 1889)							12,819	20,844	18,057	29,133	33,902	34,821	42,831
§27	(Annexed July 15,		1889. Includes all		so Norwood Park, an		nexed Nov. 7, 1893,		when marked*)			11,368	10,734	14,702	*19,668	*25,151	*33,999
Totals..	1,813	.....	.....	.....	.....	.....	5,076	.....	13,374	16,960	23,899	32,212	28,791	43,835	53,570	59,972	76,830

†Town of Jefferson. ‡Ordinance Oct. 31, 1887, and May 20, 1889. §Ordinance July 22, 1889, and Nov. 27, 1893.

GEOGRAPHICAL DISTRICT No. IV.

WARD.												School 1890	U. S. 1890	School 1892	School 1894	School 1896	School 1898
*28	(Formerly part of Cicero, Annexed April 9, 1889).							.....	.....	.....	.....	8,785	9,046	12,645	18,287	22,693	28,434

*Ordinance July 22, 1889.

POPULATION OF THE CITY OF CHICAGO—WEST DIVISION—Continued.

SUMMARY.

DISTRICT.	U. S. 1870						U. S. 1880		School 1884	School 1886	School 1888	School 1890	U. S. 1890	School 1892	School 1894	School 1896	School 1898
No. I.....	70,629	.....	.....	.....	.....	.....	92,687	.....	107,388	113,723	116,519	132,312	114,242	149,569	144,818	125,580	136,372
No. II.....	75,089	.....	.....	.....	.....	.....	183,538	.....	244,543	279,182	324,929	394,576	371,706	454,081	499,528	526,000	602,608
No. III....	1,813	.....	.....	.....	.....	.....	5,076	.....	13,374	16,960	23,899	32,212	28,791	43,835	53,570	59,972	76,830
No. IV....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8,785	9,046	12,645	18,287	22,693	28,434
Totals..	147,531	.....	.....	.....	.....	.....	281,301	.....	365,305	409,865	465,347	567,885	523,785	660,130	716,203	734,245	844,244

APPENDIX F.

TABLE SHOWING COMMERCE IN THE CHICAGO RIVER, 1893 TO 1898.

YEAR.	ARRIVALS.		CLEARANCES.		TOTALS.		Average Cargo, Tons.
	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.	
1883	11,203	3,555,586	11,271	3,743,574	22,474	7,299,160	325
1884	10,513	3,481,957	10,640	3,489,666	21,153	6,971,623	330
1885	9,846	3,347,647	9,910	3,364,169	19,756	6,711,816	340
1886	10,180	3,564,309	10,267	3,594,549	20,447	7,158,858	350
1887	10,828	3,868,465	10,920	3,989,615	21,748	7,858,080	361
1888	10,158	3,990,921	10,308	4,134,064	20,466	8,124,985	397
1889	9,552	4,417,415	9,462	4,403,634	19,014	8,821,049	464
1890	9,188	4,344,502	9,284	4,429,654	18,472	8,774,156	475
1891	8,956	4,569,526	9,144	4,698,320	18,100	9,267,846	507
1892	9,073	4,798,241	9,252	4,976,216	18,325	9,774,457	533
1893	8,011	4,892,580	8,062	4,914,854	16,073	9,807,434	610
1894	7,318	4,328,685	7,379	4,358,359	14,697	8,687,044	591
1895	7,637	4,602,508	7,687	4,585,831	15,324	9,188,339	600
1896	7,154	4,787,250	7,102	4,719,522	14,256	9,506,772	667
1897	7,619	5,340,648	7,551	5,268,225	15,170	10,608,873	699
1898	7,624	5,285,559	7,763	5,466,321	15,387	10,751,880	699

TABLE SHOWING MOVEMENTS OF VESSELS IN THE CHICAGO RIVER. FROM RECORDS OF THE OFFICE OF THE CITY VESSEL DISPATCHER SHOWING NUMBER OF VESSELS PASSING RUSH STREET BRIDGE.

MONTH.	TOTAL NUMBER FOR MONTH.										
	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899
May	....	2,168	2,212	*2,201	1,915	1,446	....	1,267	1,519	1,504	1,190
June	2,589	2,522	2,643	....	2,141	1,694	1,726	1,523	1,756	1,877	1,659
July	2,948	2,027	2,159	....	1,651	1,655	1,638	1,767	2,029	2,093	2,083
August	3,083	2,908	2,112	....	1,492	1,802	1,821	1,644	1,965	2,162	1,740
September	2,579	2,083	2,053	....	1,356	1,639	1,470	1,304	1,801	1,641	1,512

MONTH.	AVERAGE NUMBER PER DAY.										
	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899
May	....	70	71	*71	62	47	....	41	49	49	38
June	86	84	88	....	71	56	58	51	59	63	55
July	95	65	70	....	53	53	53	57	65	68	67
August	99	94	68	....	48	58	59	53	63	70	56
September	86	69	68	....	44	55	49	43	60	55	50

MONTH.	MAXIMUM NUMBER ONE DAY DURING MONTH.										
	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899
May	....	92	103	*99	104	76	....	82	72	71	64
June	107	109	109	....	108	95	84	78	75	81	83
July	131	119	113	....	84	79	83	86	83	87	85
August	126	121	105	....	68	76	89	79	89	93	95
September	131	106	100	....	67	80	76	63	85	73	75

*From record of entries and clearances published in *The Chicago Tribune.*

APPENDIX G.

DAILY REGISTER, SPRINGFIELD, ILLS., March 22, 1849.

GREAT LOSS OF LIFE AND PROPERTY—GREATEST FLOOD EVER KNOWN IN CHICAGO.

From the Will County Democrat.

Chicago, March 12, 8 p. m.—Never before has Chicago been visited by so great a calamity as this day has been witnessed. Our harbor exhibits a scene of the most terrible devastation. In the confusion which prevails, it would be idle to attempt to give the details; but we believe it is not too much to say that one-half of the shipping in the harbor has been destroyed, and every bridge upon the river has been swept away. About 9 o'clock this morning a compact dam of ice, raised two or three feet above the surface of the water, nearly opposite Gage & Hains' steam mill, on the South Branch, and above which a large body of water and floating ice had accumulated, suddenly gave way, sweeping down the rapid current every vessel lying below that point. Madison street bridge offered a momentary check to the floating mass, but it was momentary; for the next instant the bridge itself was added to the wreck. Randolph street bridge was the next obstacle to the rush of things, but hardly an obstacle. It resisted for a moment, and then it gave way and sunk into the chaos below, and all rushed with swift destruction upon the large number of vessels and canal boats

lying in the branch in the vicinity of Raymond & Gibbs' warehouse. The fleet of destruction thus swept into the main river, where the banks were lined with steamers, propellers, brigs, schooners and canal boats, and then such a crushing confusion ensued as no pen can describe. Wells street bridge was open, leaving the middle of the stream clear; but the vessels were closely wedged together from bank to bank, and the ends of the bridge very soon gave way and mingled with the general wreck. On, on rushed the terrible flotilla, the whole river being completely filled with steamboats, propellers, schooners, canal boats, scows and every kind of craft. In the harbor above, the booms, bowsprits and other portions of the rigging crushing on the mass moved on below, the hulls coming together with a still greater crash, the smaller craft being ground to fragments between the larger and the ice, which covered the whole surface of the water, and was often wedged in several feet above. Clark street bridge was completely swept away, and a large number of large vessels were wedged together at this point with smaller ones filling the space between, and such a crushing it is impossible to describe. The hulls gave way as if they had been egg shells. Those at the edge ground against the wharfs, tearing up the planks; the rigging was mingled together in the greatest confusion—spars and cables of the largest size snapped every moment as if they had been twine. The vessels were crowded with persons shouting and endeavoring to do something to arrest their progress below this point. Twelve o'clock.—The mass of vessels still remains wedged in above the garrison, and an immense amount of ice and wreck is accumulating above, and rendering the pressure against the shipping fearful. A number of vessels have been swept beyond the piers and are now riding at anchor. Several boats are out upon the lake, some with men on board, and others entirely destroyed. The whole surface of the lake for miles out is covered with floating wrecks. The vessels in the North Branch are still safe,

though fears are entertained that they too may be swept out. Sixteen schooners and vessels injured and sunk, seven propellers and steamboats ditto, five children, four men and one woman killed.

LATER.—Chicago, March 13, 10 o'clock a. m.

The dam still remains, but the ice has for the most part passed under the vessels, and the water has fallen some two feet.

Some apprehensions are entertained, when the North Branch gives way, that it will bring vessels and canal boats with it, and make a general destruction at the dam. They are trying to get the boats loose below. Some probability that they will succeed. Much damage has been done at Peru by high water. Twenty buildings have already been destroyed, and the water is still rising. The hydraulic basin at Lockport gave way on the night of the 12th inst. About fifty feet of the west wall has been entirely carried away.

APPENDIX H.

CHICAGO, October 28, 1899.

DESMOND FITZGERALD, ESQ.,

Engineer Special Commission, Sanitary District of Chicago.

DEAR SIR:—Taking up the subject of bridges already constructed by this District or which must be built to meet the needs of the channel and comply with contract requirements, I have to advise you as follows:

The bridge at Taylor Street now under construction is to be a movable structure of the rolling lift type, the entire cost of which, including operating machinery, is to be borne by the District. It is to be operated and hereafter maintained by the City of Chicago.

The railroad bridge being constructed for the Chicago Terminal Transfer Railroad, just south of Taylor Street, is also of the rolling lift type. The first cost of the entire structure, fully equipped for service, is to be borne by the Sanitary District. According to the contract dated December 6th, "The said bridge and all of its appurtenances when completed shall become the property of and shall thereafter be maintained by said railroad company at its own expense" (see proceedings December 28, 1898, page 5359).

The bridge at Canal Street is to be of the bascule type. The City of Chicago contributes $35,000 to its construction and after its completion owns, operates and maintains the structure free of cost to the Sanitary District. Said District pays all of the cost of construction and equipment in excess of $35,000. (See proceedings, page 6037.)

The entire cost of the double roadway bridge constructed across the channel for use at Western avenue and the Southwest boulevard has been borne by the Sanitary District, which must also maintain the structure and must equip it with rotating mechanism, and operate it when it goes into commission as a swing bridge. (See proceedings Oct. 16, 1895, page 2890; June 23, 1897, page 4087; also Aug. 14, 1895, page 2770.)

The eight track bridge now being constructed for the use of the Pennsylvania Co. Southwest Division (four tracks); the Chicago Terminal Transfer Co. (originally C. & N. P. Ry.) two tracks, and the Chicago Junction Ry. Co. (originally the U. S. Y. & T. Co.) two tracks, covered by separate contracts with each of the corporations named, the terms in each contract being practically the same and briefly stated as follows: The District to bear the entire cost of construction as a fixed bridge and to pay a sum, the interest on which "at five per cent per annum shall be sufficient to defray the cost of maintenance of said fixed bridge including all ordinary or special repairs of the same." Later, when the bridge is to be used as a movable structure, the Sanitary District must complete and equip it as such structure, together with an interlocking signal plant for its protection, and must pay "a sum of money the interest of which computed at the rate of five per cent per annum shall be sufficient to defray the cost of maintenance and operation of such draw or movable bridge, including all ordinary or special repairs of same including the interlocking signals herein provided for." (See proceedings for 1895, pages 2784, 2920, 2923; Proceedings for 1897, pages 3966, 3984; Proceedings for 1898, page 5381.)

The contract with the Chicago, Madison & Northern Railroad Company (Illinois Central) is found in proceedings for 1897, page 4090 *et sequiter.* This bridge is completed except the equipment of rotating machinery. The agreed capitalization for maintenance is (*a*) the annual cost of cleaning and painting, .03 of one cent per pound computed on the whole weight of

metal contained in the structure; (*b*) the annual cost of removing cross ties and guard rails on structure, five dollars ($5.00) per thousand feet B. M.; (*c*) annual cost of general inspection and minor repairs, twenty cents per lineal foot computed on entire length of said structure; (*d*) for annual depreciation in value and liability to accident, one and one-half (1½) per cent of the cost of all metal in structure erected in place. Twenty-five times the sum of the four items above enumerated has been paid to the railroad company. This bridge when required to be operated as a swing bridge is to be equipped with rotating machinery and interlocking signal devices at the expense of the Sanitary District and "before such draw or swing bridge shall have been operated as such, the respective chief engineers of the parties hereto shall determine the estimated annual cost of maintaining, renewing and operating the said draw or swing bridge and said interlocking system and the estimated annual depreciation in value of the same, and the Sanitary District shall pay to the railroad company a sum of money in cash equal to twenty-five times the amount so determined," etc., etc.

The bridges of the Atchison, Topeka & Santa Fe R. R., built entirely at the cost of the Sanitary District, are covered by contract of May 25, 1896, and modifications thereof dated October 27, 1897, and October 12, 1898 (see Proceedings, pages 3360, 4331, 5435). These contracts define the obligations of the parties to them more fully than any of the other contracts between the District and the railroads.

"Section 15: The Sanitary District shall pay to said Atchison Company, within the time hereinafter fixed, as compensation for the ordinary maintenance and repair of the bridge structure referred to in Section 3 hereof, and shown on Exhibit C, a sum in cash to be arrived at as follows:

"(*a*) The annual cost of painting said structure shall be estimated at three-hundredths of a cent per pound of the weight of iron and steel in the structure, exclusive of the guard rail

bolts and the rails, spikes and fastenings in the tracks over said structure.

"(*b*) The annual cost of the renewal of cross ties and guard rails shall be estimated at five dollars per thousand feet B. M. of the lumber in said cross ties and guard rails.

"(*c*) The annual cost of inspection and minor repairs, such as tightening rivets, adjusting truss rods and minor repairs to floor systems, including the general inspection and care of the bridges, shall be estimated at 20 cents per lin. ft. of track crossing said bridges.

"The total estimated annual charge for ordinary maintenance and repair shall be composed of the three items above mentioned, and twenty times the sum so arrived at shall, within the time hereafter mentioned, be paid by the Sanitary District to said Atchison Company as compensation, it being estimated that the sum so paid, at five per cent interest, will yield a revenue equal to the estimated expenditure for ordinary maintenance and repair.

"Section 16: Said Sanitary District shall also pay, within the time hereinafter fixed, to said Atchison Company, in addition to the sum provided for in the preceding Section (15) as compensation for the general depreciation and wearing out of the bridge mentioned in Section 2 of this Article, and for assuming all liability of accident to the same, a sum in cash to be arrived at as follows:

"The annual depreciation of the wrought iron or steel in the bridge structure shall be estimated at the rate of one and one-half per cent of the total cost of the iron and steel in said structure, erected in place; said cost to be arrived at and verified by the Chief Engineer of the Sanitary District and the Chief Engineer of the Atchison Company, and twenty times the sum so ascertained shall be agreed upon as the amount that said Sanitary District shall pay to the said Atchison Company for assuming all liability for general depreciation, wearing out and accident, and on the payments mentioned in this and the preceding Section (15) being made, said company shall hereafter keep said bridge in safe order and repair.

"(*a*) The annual depreciation and wearing out of the superstructure of the bridges, and for increased liability to accident, shall be estimated at the sum of one-half of one per cent (½%)

of the total cost of the iron and steel in the trusses, floor and bracing of said structure erected in place, exclusive of the rotating machinery, circular tracks, wheels, steel facing of drum, racks, pinions and shafting, boilers, engines and all fixtures and appurtenances belonging thereto, the drum to be classed as a part of the truss system.

"(*b*) The annual depreciation and maintenance and liability to accident of the entire rotating machinery, including circular tracks, wheels, steel facing of drum, racks, pinions, shafting, boilers and engines, and the wedge shoes of end supports, and all attachments and appurtenances thereto, shall be estimated at the sum of 7½ per cent of the entire cost of the same in place.

"(*c*) The annual depreciation and maintenance of pile and frame protection piers, and for liability of accident to same, shall be estimated at the sum of 12½ per cent of the entire cost of said superstructure.

"(*d*) The annual compensation for operating said draw spans or movable bridges, including wages of engineers, tower men, lamp men, and all others employed in connection with operating and maintaining the bridges and interlocking plants connected therewith, also for fuel, oil, waste and all other supplies and materials, and including the maintenance and depreciation of said interlocking plants, shall be estimated at the sum of $4,300.00 for each of said draw or movable bridges.

"The aggregate of the foregoing additional amounts or compensation shall be ascertained and verified by the Chief Engineer of the Sanitary District and the Chief Engineer of the Kansas Company in advance of and before changing or converting any of said bridges from fixed spans to draw or movable bridges, or before constructing any draw or movable bridge provided for in Section 1 of Article IV of said agreement and twenty times the sum so determined shall be paid by the Sanitary District to the railway company owning the line upon which such bridge or bridges may be constructed before any such bridge or bridges shall be operated as draw or movable structures or bridges."

The contract with the Belt Railway of Chicago covering a four track swing bridge is found in proceedings for January 11, 1899:

"Section 8. The Sanitary District shall pay to the Belt Company, within the time hereinafter fixed, as compensation and indemnity for the maintenance, renewal, repair and liability to accident of the bridge structure above provided for and treated as a fixed bridge, a sum of money amounting to twenty-five times the total of the following four items:

"(*a*) The annual cost of painting said structure, which shall be estimated at three one-hundredths (.03) of one cent per pound computed on the whole weight of metal contained in said bridge structure, not including track material.

"(*b*) The annual cost of renewal of cross ties and guard rails, estimated at $5.00 per thousand feet B. M., computed on all the lumber in said cross ties and guard rails.

"(*c*) The annual cost of general inspection and minor repairs, estimated at twenty cents per lineal foot of track crossing said bridge.

"(*d*) The annual depreciation in value and liability to accident, estimated at two per cent of the entire cost of the metal in said structure erected in place, including in such cost the cost of the design and plans for such bridge and of all supervision and inspection employed in the construction thereof.

"The amount of the four items above shall be verified by the Chief Engineer of the Sanitary District and the Engineer of the Belt Company and ninety per cent of the preliminary estimate of such engineers of the total amount above provided for shall be paid by the Sanitary District to the Belt Company as soon as the contract for the construction of said bridge has been let in accordance with the provisions of Sections 2 and 3 of this Article, and before the Sanitary District may enter upon any portion of said right of way.

"Said railroad companies shall be the sole and exclusive owners of said bridge and shall have entire charge of and control over the same, subject only to the provisions of Article III hereof. But until the payments provided for in this Article shall have been fully made the Sanitary District shall, at its own expense, maintain said bridge structure in good condition.

"Section 1, Article III. If at any time hereafter any State or Federal authority shall require the bridge provided for in Article I to be operated as a draw or swinging bridge, the Sanitary District shall, at its own expense, equip said bridge with such rotating mechanism and make such alterations in and additions to said bridge and to the substructure thereof, including proper protection for the piers and abutments of said bridge, as shall be necessary to operate it as a draw or swinging bridge; provided that such rotating mechanism and all such equipments of said bridge and alterations in or additions thereto and to the substructure thereof, or any changes therein, shall be constructed according to plans and specifications that shall have been approved in writing by the Engineer of the Belt Company before any such work shall have been commenced or contracts let therefor; and such Engineer shall have the right to inspect any material or workmanship used in such construction, and reject all that he shall not consider first-class and suitable; and provided further that the Sanitary District shall, at its own expense, and before such draw or swinging bridge shall have been operated as such, furnish, complete and install an interlocking derailing and signaling system for the protection of trains crossing said bridge; the said interlocking system to be designed, constructed and installed to the entire satisfaction of the Engineer of the Belt Company; and provided, further, that before such draw or swinging bridge shall be operated as such the Sanitary District shall pay to the Belt Company a sum of money in cash equal to twenty-five times the amount of the following five items, in addition to the sum of money provided to be paid by the Sanitary District under the provisions of Article I hereof, namely:

"(*a*) For the increased annual depreciation and wearing out of the superstructure of such bridge, and for increased liability to accident thereto on account of the same being used as a swinging bridge, the sum of one-half of one per cent of the total cost of the superstructure of said bridge as described in Paragraph *d* of Section 8 of Article I.

"(*b*) For annual depreciation, repair, renewal and liability to accident of the entire rotating machinery, including every item entering into the cost of installing the same complete, the sum of seven and one-half per cent of the entire cost thereof.

"(*c*) For annual depreciation, renewal and repair of pile and frame pier and abutment protection, and for liability to accident to the same, the sum of 12½ per cent. of the entire cost of said structures.

"(*d*) For the annual depreciation, repair and renewal of the interlocking plant, and for liability to accident thereto, the sum of 10 per cent. of the total cost of such interlocking plant.

"(*e*) For the annual compensation for operating said draw span and interlocking plant, including wages of engineers, tower men, lamp men and all others employed in connection with operating and maintaining the bridge and interlocking plant connected therewith, also for fuel, oil, waste, and all other supplies and materials, etc., the sum of $5,000,00.

"The aggregate of the foregoing five amounts shall be verified by the Chief Engineer of the Sanitary District and the Engineer of the Belt Company before such bridge shall be changed and converted from a fixed span to a draw or movable span, and twenty-five (25) times the amount so determined shall be paid by the Sanitary District to the Belt Company before such bridge shall be operated as a draw or movable structure."

The contract for the Chicago Terminal Transfer R. R., dated Sept. 3, 1897, is found in the proceedings for 1898, page 5381.

"Section 8: The Sanitary District shall pay to the said Railroad Company, as compensation for the ordinary maintenance and repair of the bridge structure referred to in Section 1 hereof, and the span referred to in Section 3 hereof and shown on Exhibit A, as soon as same are completed, a sum in cash to be arrived at as follows:

"(*a*) the annual cost of painting said structure shall be estimated at .03 of a cent per pound of the weight of iron and steel in structure, exclusive of the guard rail bolts, and the rails, spikes and fastenings in the tracks over said structure.

"(*b*) The annual cost of the renewal of cross ties and guard rails shall be estimated at $5.00 per thousand feet B. M. of the lumber in said cross ties and guard rails.

"(*c*) The annual cost of inspection and minor repairs, such as tightening rivets, adjusting truss rods and minor repairs to floor systems, including the general inspection and care of the

said bridge and said span, shall be estimated at twenty cents per lineal foot of track crossing said bridges.

"The total estimated annual charge for ordinary maintenance and repair shall be composed of the three items above mentioned, and twenty times the sum so arrived at shall, within the time hereafter mentioned, be paid by the Sanitary District to said Railroad Company as compensation, it being estimated that the sum so paid, at 5 per cent interest, will yield a revenue equal to the estimated expenditure for ordinary maintenance and repair.

"Section 9: Said Sanitary District shall also pay to said Railroad Company, in addition to the sum so provided for in the preceding Section 8, as compensation for the general depreciation and wearing out of the bridge mentioned in Section 1 and the span mentioned in Section 2 of this Article, and for assuming all liability of accident to same, a sum in cash to be arrived at as follows:

"The annual depreciation of the wrought iron or steel in the said bridge structure and said span shall be estimated at the rate of one and one-half per cent of the total cost of the iron and steel in said structure and said span erected in place, said cost to be arrived at and verified by the Chief Engineer of the Sanitary District and the Chief Engineer of the Railroad Company, and twenty times the sum so ascertained shall be agreed upon as the amount that said Sanitary District shall pay to the said Railroad Company for assuming all liability for general depreciation, wearing out and accident, and on the payments mentioned in this and the preceding Section 8 being made, said company shall thereafter keep said bridge and span in safe order and repair.

"Article III, Section 1. In case said Sanitary District shall hereafter elect to construct draw or movable bridges in lieu of the stationary bridges across the Main Channel hereinbefore provided, it shall have the right to do so, provided said bridge shall be constructed at the exclusive cost and expense of the Sanitary District and shall be sufficient to carry all the tracks then constructed across said Channel and shall, as to design, quality of material and excellence of workmanship, be as approved in writing by the Engineer of the Railroad Company, and provided, further, that at the time of the construction